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(JOURNAL)

OF THE

ASIATIC SOCIETY OF BENGAL

—◆—
VOL. LVIII.

Rs. 52
IN.

PART I. (HISTORY, ANTIQUITIES, &c.)

(Nos. I to III.—1889 : with 10 plates ; also a Supplement with 2 plates.)

EDITED BY

THE HONORARY PHILOLOGICAL SECRETARY,

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"It will flourish, if naturalists, chemists, antiquaries, philologists, and men of science in different parts of *Asia*, will commit their observations to writing, and send them to the Asiatic Society at Calcutta. It will languish, if such communications shall be long intermitted ; and it will die away, if they shall entirely cease." SIR WM. JONES.  
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CALCUTTA :

PRINTED AT THE BAPTIST MISSION PRESS,

AND PUBLISHED BY THE

ASIATIC SOCIETY, 57, PARK STREET.

1889.

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I N D E X

TO

JOURNAL, ASIATIC SOCIETY OF BENGAL, VOL. LVIII, PART I,

FOR

1889.

ABU BAKR, unique coin of, p. 32.
 Alĥmad II, of Gujarāt, pp. 3, 10.
 Antiquities at Rāmpāl, pp. 12, 17.
 ——— at Bhitari, p. 87.
 ——— at Sāwaldhor, p. 171.
 Athene, statuette of, pp. 121, 150.
 Atlantean statuettes, p. 131.
 Architecture, Indo-Hellenic, pp. 109, 119,
 121, 139, 150.
 ———, Indo-Persian, p. 109.
 ———, Indo-Corinthian, pp. 116,
 130, 149, 161, 164.

B. A. ADAM, mosque of, pp. 17, 24, 26,
 27.
 ———, legend of, p. 18.
 Bahmanī coins, pp. 11, 12.
 Bālāditya, a Gupta title, p. 93.
 Ballāl-bārī, p. 26.
 Ballal Sen, of Bengal, pp. 12, 16—19.
 Bhitari, antiquities at, pp. 87, 154.
 Birthscene of Buddha, p. 123.
 Birthstories of Buddha, p. 130.
 Buddha, statues of, pp. 122, 126.
 ———, with moustaches, p. 122.
 ———, birthscene of, p. 123.
 ———, deathbed scene, p. 124.
 ———, hair of, p. 123.
 Buddha Gayā, sculptures at, p. 138.

CHANDEL coins, p. 34.
 Christian art, resembling that of Gān-
 dhāra, pp. 164—166, 176.
 Chronological Tables of Tibet, p. 40.
 Chronology of Gāndhāra school of sculp-
 ture, p. 141.
 Civilization of India, Græco-Roman
 influence on, p. 107.
 Coinage, art of, in India, p. 177.

Coins of the Muhammadan Kings of
 Gujarāt, p. 1:
 ——— Ghiyāsu-d-dīn Karīm Shāh, p. 8.
 ——— Maĥmūd Shāh I, p. 8.
 ——— Muẓaffar Shāh II, p. 9.
 ——— Bahmanī, pp. 11, 12.
 ——— Bahādur Shāh, p. 10.
 ——— Maĥmūd Shāh III, p. 10.
 ——— Alĥmad Shāh II, p. 10.
 ——— Muĥammad Shāh, the pretender,
 p. 11.
 ——— Muẓaffar Shāh III, p. 11.
 ——— Muĥammad Shāh II, Bahmanī,
 p. 11.
 ——— Maĥmūd Shāh II, Bahmanī, p. 12.
 ——— from Hoshangābād, p. 30.
 ——— of Muhammad bin Tughlaq, p. 31.
 ——— Ghiyāsu-d-dīn Tughlaq II, p. 31.
 ——— Abu Bakr, p. 32.
 ——— Sikandar bin Ilyās, p. 32.
 ——— Firūz Shāh and Fath Khān, p. 33.
 ——— Saifu-d-dīn Qurlagh, p. 33.
 ——— Paramarddi Deva, p. 34.
 ——— Vīra Varma, p. 34.
 ——— Bāla Varma, p. 34.
 ——— Gondophares, pp. 145, 147.
 ——— Kanishka, pp. 147, 148.
 ——— Kumāra Gupta, p. 154.
 ——— of Hashtanagar, p. 144.
 ——— date of Indian, p. 178.
 Comic friezes, in Gāndhāra, pp. 136, 169.
 Cycle, of Vṛihaspati or 60 years, p. 40.

DAS, Babu S. Ch., Life of Sum-pa
 Khān-po, author of the Reĥumig,
 p. 37.
 Death-bed scene of Buddha, p. 124.
 Dehli, rulers of, pp. 6—8.
 Dekkan, rulers of, p. 6—8.
 Devāgupta, p. 103.
 Drama, origin of Indian, p. 184.
 Droṇasipha, the Valabhi King, p. 97.

ERA, Kalachuri, p. 103.

FATH KHÁN, coin of, p. 33.

FIRUZ SHAH, coin of, p. 33.

Friezes, comic, in Gándhára, pp. 136, 169.

GAJARIYA tree, in Rámpál, p. 21.
Gándhára, boundaries of, p. 111.

———, notices of School of Art in, p. 113.

———, school of sculpture described, p. 119.

———, date of art, pp. 128, 150, 153.

———, subjects of its art, p. 129.

———, chronology of school of sculpture, p. 141.

———, inscriptions in, p. 142.

Ganymede, rape of, in Gándhára, p. 133.

Garuda device on seals, pp. 85, 86.

Genealogical table of Kings of Gujarát, p. 6.

Genealogy of the early Gupta Dynasty, p. 91.

Ghiyasu-d-din Tughlaq II, unique coins of, p. 31.

Gigantomachia in Gándhára, p. 132.

Gondophares, coins of, pp. 145, 147.

Græco-Roman influence on the Civilization of India, p. 107.

Gujarát, coins of, p. 1.

———, kings of, pp. 2—8.

Gupta, Asutosh, Ruins and Antiquities of Rámpál, p. 12.

Guptas, early, genealogy of, p. 91.

———, history of, p. 95.

———, coinage of, p. 93.

———, relation of Later Guptas to, p. 94.

HAIR of Buddha, form of, p. 128.

Hashtanagar, p. 152; inscription, p. 144.

Hellenistic sculpture in Gándhára, p. 119.

——— in India Proper, p. 137.

Hoernle, Dr. A. F. Rudolf, on some new or rare Hindú and Muhammadan coins, No. I, p. 30.

——— Remarks on an inscribed seal of Kumára Gupta, p. 88.

Huna, invasion of India, pp. 99, 101.

IMPERIAL dignity, in India, fortunes of, p. 101.

Indo-Corinthian architecture, pp. 116, 130, 161, 164.

Indo-Corinthian points of similarity with pure Corinthian, p. 118.

——— date of its capitals, p. 163.

Indo-Hellenic architecture, p. 109.

Indo-Persian architecture, p. 109.

Inscription of Jalálu-d-din Fath Sháh, pp. 17, 23.

——— in Qazi Qasbah mosque, pp. 24, 25.

——— in Gándhára, p. 142.

JALÁLU-D-DÍN Fath Sháh, of Bengal, p. 17.

———, inscription of, pp. 17, 23.

Jamalgarhi, remains of architecture, pp. 117, 119, 122, 129, 130, 131, 148, 162, 170.

———, date of, p. 119.

Játakas or birthstories, p. 130.

Jaunpur, rulers of, pp. 6—8.

KACHKY Dwarja, name of a road, pp. 22, 23.

Kalachuri era, p. 103.

Kandaish, rulers of, pp. 6—8.

Káshmir, Doric pillars in, p. 110. [88.]

Kumára Gupta, inscribed seal of, pp. 84,

LANMAN, Prof. R., the Namuchi-myth, p. 28.

MAHMUD III, of Gujarát, pp. 2, 10.

Málwá, rulers, of, pp. 6—8.

Manikyála, pp. 112, 151.

Masjid of Ba-Adam, pp. 17, 24, 26, 27.

——— of Qazi, p. 22.

——— of Qazi Qasbah, pp. 17, 24.

——— of Rikábi Bazár, pp. 24, 25, 27.

Mathurá, sculptures at, pp. 139, 140.

Maukhari, rulers in India, p. 102.

Mihirakula, p. 95.

Moustaches, on Buddha, p. 122.

Muhammad bin Tughlaq, unique coin of, p. 31.

Muzaffar III, of Gujarát, pp. 3, 11.

Mythology, Græco-Roman influence on Indian, p. 190.

NAMUCHI Myth, p. 28.

Nitagupta, coins of, p. 93.

Narasimha Gupta, p. 95.

Nathú, see Muzaffar III.

Nuttu Monastery, sculptures at, pp. 125, 127, 167, 170.

OLIVER, E. E, Coins of the Muhammadan Kings of Gujarát, p. 1.

PAINTING, Indian Schools of, p. 173.
 ———, date of Ajañta, p. 176.
 Pesháwer or Gándhára school of sculpture, pp. 119, 141.
 Philosophy, Græco-Roman influence on Indian, p. 190.
 Pillars, Indo-Persian, p. 109.
 ———, Corinthian, p. 116.
 ———, Doric, p. 110.
 ———, Ionic, pp. 115, 150.
 Puragupta, pp. 92, 95.

QAZI, mosque of, p. 22.
 Qāzi Qaṣbah, mosque of, pp. 17, 24, 25.

RAJATARANGINĪ, errors in, p. 99.
 Rāmpāl, ruins and antiquities of, pp. 12, 17.
 ———, dighí or lake of, pp. 20, 21, 22.
 ———, Gañj-á tree in, p. 21.
 Ránigat, fortress of, p. 127.
 Rupe of Ganymede, in Gándhára, p. 133.
 Rehmig, Chronology of Tibet, p. 40.
 Religion, Græco-Roman influence on Indian, p. 190.
 Rikabí Bazār mosque, pp. 24, 25, 27.
 Rome, its intercourse with India, p. 157.
 ———, date of the influence of its art on India, p. 159.

SAIFU-D-DĪN Qurlagh, coins of, p. 33.
 Sáma Játaka, p. 130.
 Saughao, sculptures in, pp. 147, 148, 170.
 Sáwaldher, remains at, p. 171.
 Science, Græco-Roman influence on Indian, p. 190.
 Sculpture, art of, in Gándhára, p. 119.
 ———, ———, in India proper, p. 137.
 ———, ———, chronology of, pp. 141, 150, 153.
 ———, Christian, resembling that of Gándhára, p. 166.

Seal, inscribed, of Kumára Gupta, pp. 82, 88.

———, of Harsha Vardhana, p. 86.

Sen kings of Bengal, p. 12.

——— their caste, p. 13.

Sikandar bin Ilayás, unique gold coin of, p. 32.

Smyth, V. A., Inscribed Seal of Kumára Gupta, p. 84.

———, Græco-Roman influence on Civilization of India, p. 107.

Statuette of Athene, p. 121.

——— of Buddha, p. 127.

——— Atlantean, p. 131.

Sum-po Khan-po, author of a Tibetan chronology, p. 37.

Synchronistic table of the early Guptas and others, p. 101.

——— of the rulers of Gujarát, etc., pp. 6—8.

TABLE, genealogical of kings of Gujarát, p. 6.

———, synchronistic of rulers of Gujarát, etc., pp. 6—8.

———, chronological, of Tibet, p. 40.

Takht-i-Bahí, remains of architecture, pp. 117, 171.

———, inscription at, p. 145.

Taxila, p. 112.

———, buddhist temple at, pp. 114, 115.

———, Ionic pillars at, pp. 115, 150.

———, statuette at, p. 127.

———, inscriptions at, p. 142.

Tibet, chronology of, p. 40.

Toramána, p. 98.

UCHCHAKALPA Mahárájas p. 103.

VRIHASPATI cycle, p. 40.

WATERSPOUTS, pp. 27, 28.
 Wessantara játaka, p. 130.

CONTENTS

OF

JOURNAL, ASIATIC SOCIETY OF BENGAL, VOL. LVIII, PART I,
FOR 1889.

Page

No. I.

<i>Coins of the Muhammadan Kings of Gujardt.</i> —By E. E. OLIVER, ESQ. (With 3 plates)	1
<i>Ruins and Antiquities of Rámpál.</i> —By ASUTOSH GUPTA, ESQ., C. S. (With an editorial note and a plate)	12
<i>The Namuchi-myth; or an attempt to explain the text of Rigveda viii. 14. 13.</i> —By CHARLES R. LANMAN, Professor in Harvard College, Cambridge, Mass., U. S. A.	28
<i>On some new or rare Muhammadan and Hindú Coins.</i> —By DR. A. F. RUDOLF HOERNLE. (With a plate)	30

No. II.

<i>Life of Sum-pa Khan-po, also styled Yesos-Dpal-hbyor, the author of the Reñumig (Chronological Table).</i> —By BÁBÚ SARAT-CHANDRA DÁS, C. I. E.	37
<i>Inscribed Seal of Kumára Gupta.</i> —By V. A. SMITH, ESQ., C. S. (With a plate)	84
<i>Remarks on the above. (With a synchronistic table).</i> —By DR. A. F. RUDOLF HOERNLE	88

No. III.

<i>Græco-Roman Influence on the Civilization of India.</i> —By V. A. SMITH, ESQ., C. S. (With four plates)	107
---	-----

SUPPLEMENT.

<i>Catalogue of the Central Asiatic Coins, collected by Captain A. F. De Læssøe, in the Indian Museum, Calcutta.</i> —By DR. A. F. RUDOLF HOERNLE. (With two plates)	1
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LIST OF PLATES

IN

JOURNAL, ASIATIC SOCIETY OF BENGAL, VOL. LVIII, PART I,
FOR 1889.

Pls. I—IV (pp. 8—12). Coins of the Muhammadan Kings of Gujarát.

Pl. V (p. 23). Inscription of Jalálu-d-dín Fath Sháh, dated 888 A. H.

Pl. VI (p. 85). Copper-silver seal of Kumára Gupta II.

Pl. VII (p. 121). Pallas Athéné, Lahore Museum.

Pl. VIII (p. 122). Throned King, Lahore Museum.

Pl. IX (pp. 123, 127, 129, 131). Gándhára Sculptures, Indian Museum.

Pl. X (p. 144). Inscribed Pedestal, from Hashtnagar.

Synchronistic Table of the Reigns of the Early Gupta and their Contemporaries and Immediate Successors (p. 101).

No. 52
IN

Vol. LIII, Pt. II, 1889

JOURNAL

(OF THE)

ASIATIC SOCIETY OF BENGAL.

Part I.—HISTORY, LITERATURE, &c.

No. I.—1889.

Coins of the Muhammadan Kings of Gujarát.—By E. E. OLIVER, ESQ.

(With 3 Plates.)

Looking over a large number of coins belonging to Mr. Furdoonjee, an enthusiastic numismatist of Bombay—in which Presidency he had exceptional opportunities for collecting the coins of the old Muhammadan dynasty of Gujarát—I find a good number that do not appear in the British Museum Catalogue, nor in the list given by Thomas, and that, so far as I am aware, have not yet been described. Supplemented with some from my own cabinet, I have filled two or three plates, which may be interesting in continuation of those described by Mr. Poole from the National Collection.

It is unnecessary to attempt any sketch of the dynasty, that for over a century and a half, ruled the destinies of Gujarát. One of the principal of those Muhammadan States that sprung from the ruins of Muhammad ibn Tughlaq's declining empire; and maintained more or less of splendour and of power, till they were once again reduced to provinces of Dehli by Akbar. A useful general outline of the leading events is given in Mr. Stanley Lane Poole's introduction to the volume in the British Museum series above referred to, treating of the minor Muhammadan States; and the late Sir Edward Clive Bayley in his volume on the history of Gujarát, has brought together the more inter-

estirg particulars as told by the native historians in the *Mirāt-i-Aḥmadī* and the *Mirdt-i-Sikandarī*.

In both, however, there is a little blank between the assassination of Maḥmūd III., and the final incorporation of the State into the Mughal Empire. This is a period regarding which most historians are silent; probably for the very excellent reasons, that there are no very accurate materials, and the accounts of native writers are somewhat conflicting, while it is perfectly accurate and more easy to sum up the whole, as being "thirty years of anarchy."

Briefly, the outline of those thirty years of anarchy is somewhat as follows: Maḥmūd III was murdered by a slave named Burhān in Maḥmūdābād, on the 12th Rabi'ū-l-awwal, 961 H. (the eve of the 13th according to the *Mirāt-i-Sikandarī*), which slave in addition entrapped and killed some twelve of the chief Gujarāt nobles. Among those sagacious enough not to fall into Burhān's trap was one I'timād Khān. Originally a Hindū servant, this I'timād, whose name may be taken to signify "trusted," had risen under Maḥmūd to a most confidential position. His master even allowed him to enter the harem, and had put him in charge of the women. He had been made an Amīr, and is spoken of as "prime minister." The morning after the murder, I'timād collected a few followers, killed Burhān, managed to pacify the city and restore order. It was to him that the court of Maḥmūdābād instinctively looked, to act as regent and to set about finding a successor to the throne. There seems little doubt, however, that whoever might be the nominal successor, I'timād determined to retain the substance of power in his own hands; and for the whole thirty years he was really the "king-maker" in the back-ground.

The accounts as to the actual arrangements made by him vary somewhat. According to the *Āin-i-Akbarī*, he raised Rāzīu-l-Mulk, "a son of Sultān Aḥmad, the founder of Aḥmadābād," to the throne. But : Sultān Aḥmad the first died in 846 H., 115 years before; and Rāzī is spoken of as "very young!" The more probable version is given in the *Mirāt-i-Sikandarī*, the author of which, Sikandarī ibn Muḥammad, was born in 961 H.; and relates that the nobles having concerted together, asked I'timād Khān, who was acquainted with the Sultān's domestic affairs, whether the Sultān had left any son, or if any of the Sultān's wives were expecting a child: if so, they would wait till the child's birth before deciding on any arrangements regarding the kingdom. I'timād said no; the Sultān had not left any son, nor were any of his wives expecting a child. As he was well acquainted with the Sultān's affairs, and denied the possibility of any direct heir, they then asked him if there was any relative of the late Sultān who was fit to

succeed to the throne, whom they might select. I'timád Khán replied that there was a relative of the Sultán at Ahmadábád, whose name was Ahmad Khán; they might send for him. Accordingly they sent Amír Razíu-l-mulk to fetch the boy. When Razí came to Ahmad Khán's house, the boy was standing at a grain-dealer's shop close by his own door, and was bringing away in the skirt of his dress some grain which he had bought for his pigeons. Razíu-l-mulk recognised him, got out of the cart, carried him off, and placing him in it, turned it round, and drove off, with very fast horses, to Mahmúdábád. The Khán's nurse wept, and made a disturbance, saying: "What is this? Where are you going to take him?" Razíu-l-Mulk called out: "I am going to take him to a place where all the world will to-morrow crowd round his house, and where he will not find one friend."

The Amír's prophecy proved true. The boy king's career was a short and a sad one. He was placed on the throne on the 15th Rabí'u-l-awwal 961 H. as Ahmad II.; the affairs of state meanwhile remaining entirely in I'timád's hands. On the coins he calls himself "Qutbu-d-dín, the son of Mahmúd," titles also adopted by the succeeding puppet. Five years later Ahmad is described as flying from his capital for refuge with one of his courtiers, but as brought back defeated. On another occasion he tried other means to get rid of his powerful minister, when the latter, beginning to feel insecure, decided to get rid of the king. One account says I'timád killed him, another that Ahmad was found murdered outside the Palace walls on the 5th Sha'bán 968 H.

Having got rid of Ahmad, I'timád now raised a child named Nathú to the throne, "who did not belong to the line of kings," but who he swore was a son of Mahmúd's. The mother, when pregnant, had been handed over to him to make her miscarry, but, the child being five months old, he had not carried out the order. The nobles had to swallow this new variety of the story, and Nathú was placed on the throne as Muzaffar III.

It was the old story of a nominal king under a powerful minister, who was the real head of the Government, and who, though several of the Amírs had secured portions of the country and declined to recognise his authority, had become practically independent. In the account of the divisions and revenues of Gujarát, given in the *Mirát-i-Ahmadí*, I'timád's establishment and income is shown in 979 H. as all but equal to the nominal kings; he having 9,000 horse and 30 *kroṣ* of "tankchahs," against Muzaffar's 10,000 horse and 33 *kroṣ* of tankchahs; the remainder of a total of 30,000 horse and 90 *kroṣ* of tankchahs, being divided amongst some half dozen nobles. The result was incessant feuds. In 980 Akbar was invited by I'timád to occupy Gujarát, and

took possession of the capital on the 14th Rājāb of that year. From then both the minister and king figure frequently in the accounts of campaigns under both Akbar and his generals. I'timād and other Gujarāt nobles proclaimed Akbar's accession from the pulpits of the mosques, and struck coin in his name, for which loyalty Baroda, Chāmpānir, and Sūrat, were given to the former as *tuyūl*, but subsequently he fell into disgrace and was made a prisoner. In 982 H. he had been released and was in charge of the imperial jewels. Two years after he went to Makkah, and on his return obtained Patan as a *jāgīr*. In 990 H. he was put in charge of Gujarāt as governor, in succession to Shihābuddīn, but the latter's forces rebelled, and went over to Muẓaffar, who in I'timād's absence took Aḥmadābād, and set up as ruler again in 991 H. Shortly after I'timād went to Patan, where he died in 995 H.

Muẓaffar abdicated in favour of Akbar in 980 H., when he was in the first instance sent to Aḡrá, but subsequently remanded to close confinement. Some nine years after he escaped, and returning to Gujarāt, collected a respectable force, defeated and slew Akbar's general Quṭbu-d-dīn Khān, and reascended the throne 991 H. (1583 A. D.). Akbar then deputed Mīrzā Khān Khānān, the son of Bairām, to retake Gujarāt. Muẓaffar was defeated the same year in a couple of pitched battles, and fled to Jūnāgarh in Kattywār. There he was pursued by another of Akbar's generals Mīrzā Khān-i-A'zam, who hunted him down and captured him in Kachh in 999 H. No sooner was Muẓaffar handed over to the Mīrzā than he asked permission to retire for a minute, and took the opportunity to cut his throat with a razor. With him terminated the dynasty of the Muhammadan kings of Gujarāt, the kingdom then becoming a province of Dehlī. The coin No. XXXI is especially interesting as having been struck during the year in which, for a brief period, Muẓaffar managed to re-establish himself in Gujarāt.

In the British Museum Catalogue there is a coin of 963, ascribed to Muḥammad, a pretender, and No. XXVIII of the series now published would seem to have somewhat similar titles and dates and also claim to be struck by a son of Maḥmūd, viz. on the Rev. *Quṭbu-d-dīn Muḥammad Shāh, (bin) as-Sultān* x 63, and on the Obv. *Nāsiru-d-dunyāwa-d-dīn Abul-Faṭḥ Maḥmūd Shāh*. On the other hand it is very similar in character to No. IX of Maḥmūd Shāh I., the son of Muḥammad, and the reading might be reversed, x being 8 instead of 9, but Muḥammad I. called himself *Ghyāṣu-d-dīn* and not *Quṭbu-d-dīn*. I have not been able to trace any historical reference to the "so-called "Pretender."

In order to facilitate comparison of dates, descent, or contemporary rulers, I add a genealogical tree of the Gujarāt kings, and a table shewing the contemporary rules in Málwá, Jaunpur, Kandaish, the Dekkan

and Dehli, taken from Peole's very handy graphic scheme of the Muhammadan dynasties of India.

(See Plates I—III.)

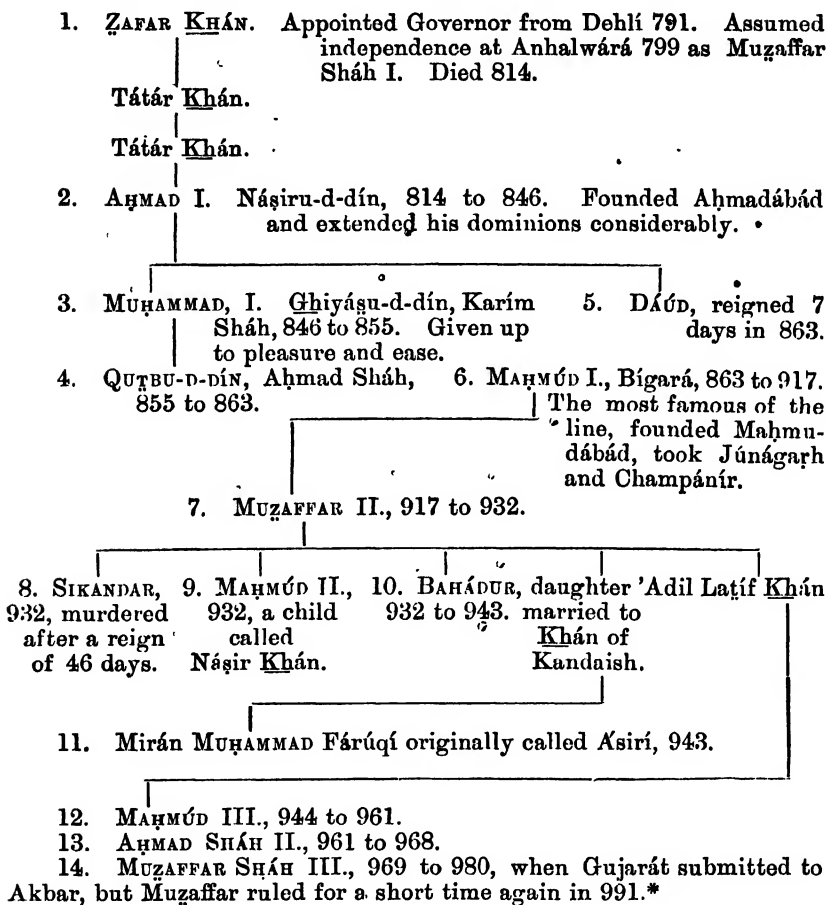
Of Ahmad Sháh I. I noticed in Mr. Furdoonjee's collection similar coins to the British Museum No. 408, but with the mint Ahmadábád for the years 832, 6, 842, 3*, and similar to No. 411 also with mint Ahmadábád, years 830-1-7. Of Ghiyásu-d-dín Muhammad Karím Sháh the Museum list gives no dated specimens. Thomas records 849, 850 and (?) 856. The three now figured read* 852, 3 and 5, the last named having the same inscription as in Thomas. The Museum catalogues no silver representative of Mahmúd Sháh *Bígará*, the famous Sultán of the moustachios. Thomas refers to three, of 891, 903 and 911. Neither give any mints: in fact, with one doubtful exception, none of the Gujarát series in the Museum catalogue are minted. In the list now given are silver coins of 864-7 (8)70, 909; Ahmadábád, 900, 903, and 911. In some cases the date is in words. The Museum list has two gold coins of Muzaffar Sháh II. Thomas's copper coins are dated 922-3-4 and 8. The one now figured is dated 929. Two others have no name but may perhaps be put down to him (?), Ahmadnagar (9)17 and 922.

The inscription on No. XVIII of Bahádur Sháh appears to agree with No. 427 of the Museum, but I note the years 938 and 939. Mahmúd Sháh III. bin Latíf is unrepresented in the Museum catalogue. Thomas gives the years 946, 7 and 9. Among these now figured are the years 945, 7 and 960. The suppositious king Ahmad II. is represented in the Museum catalogue by one copper coin; Thomas gives the dates 961—8. In the present list are the dates 961, in silver, x x 2, 963 and 8. Muzaffar Sháh III. in the Museum and in Thomas is represented by the dates 969, 971-7-8-9 and 930: The present list adds 991.

It is also worth while adding that among Mr. Furdoonjee's dated Bahmaní coins, I notice, Ahmad Sháh I. like the Museum No. 454, the years, 836 and 838. Like the Museum No. 461, the years 843-5-6, 850-2-6. Like No. 467, the years 839, 842-3 and 850. Muhammad Sháh II. like No. 474, the years 863, 877 and 875, and a fine silver coin of (?) Ahsanábád of x 77 figured in the present list as No. XXXIV. A coin of his, figured as No. XXXV, also appears a novelty.

* The above dates are all A. H.

Genealogical tree of the Muhammadan Dynasties of Gujarát.



Contemporary Rulers in

A. H.	Gujarát.	Málwá.	Jaunpur.	Kandaish.	Dekkan.	Dehlí.
795	....	....	....	....	....	Maḥmúd II.
796	....	....	Khawájah i Jahán.	....	....	..
797	....	....	....	....	....	Naṣrat.
799	Muzaffar I.	....	....	....	Ghiyásu-d-dín.	....

* The above dates are all A. H.

A. H.	Gujarát.	Málwa.	Jaunpur.	Kandaish.	Dekkan.	Dehlí.
799	....	....	....	....	Shamsu-d- dín.	....
800	....	....	....	....	Táju-d-dín Grúz.	....
802	....	....	Mubarak.	Násir.	....	Maḥmúd II.
803	....	....	Ibráhím.	....	....	....
804	....	Diláwar	....	....	....	....
808	....	Hushang.	....	....	....	....
814	Aḥmad I.	....	....	....	....	....
815	....	....	....	....	....	Ḍaulat Khán Lodí.
817	....	....	....	....	....	Khizr Khán.
824	....	....	....	....	....	Mubarak II.
825	....	....	....	....	Aḥmad I.	....
837	....	....	....	....	....	Muḥammad IV.
838	....	Muḥammad.	....	....	Aḥmad II.	....
839	....	Maḥmúd I.	....	....	....	....
841	....	....	....	Adil.	....	....
844	....	....	Maḥmúd.	....	....	....
845	....	....	....	Mubarak I.	....	....
846	Mḥd. Karím.	....	....	....	....	....
847	....	....	....	....	....	....
855	Qutbu-d-dín.	....	....	....	....	'Alím.
861	....	....	Muḥam- mad.	Ghaní.	....	Bahlol Lodí.
862	....	....	....	....	Humáyún.	....
863	Dáúd.	....	....	Husain.	....	....
865	Maḥmúd I.	....	....	....	....	....
867	....	....	....	....	Nizám.	....
880	....	Ghiyás Sháh.	....	....	Muḥammad II.	....
881	....	....	Becomes part of Dehlí.	....	....	....
887	....	....	....	....	Maḥmúd II.	....
894	....	....	....	....	Becomes split up into small provinces.	Sikandar II.
906	....	Násir Sháh.	....	....	....	....
909	....	....	....	Dáúd.	....	....
916	....	Maḥmúd II.	....	A'zam Hu- máýún.	....	....
917	Muzaḥfar II.	....	....	....	....	....
923	....	....	....	....	....	Ibráhím II.
926	....	....	....	Muḥam- mad I.	....	....
930	....	....	....	....	....	Bábar.
932	Sikandar.	....	....	....	....	....
932	Maḥmúd II.	....	....	....	....	....
932	Bahádúr.	....	....	....	....	....
937	....	Becomes part of Gujarát.	....	....	....	....
938	....	....	....	....	....	Humáyún.
942	....	....	....	Mubarak II.	....	....

A. H.	Gujarat.	Málwa.	Jaunpur.	Kandaish.	Dekkan.	Dehlí.
943	Muhammad Fárúqí.			....		....
944	Mahmúd III.			....		....
946	....			....		Sher Sháh.
952	....			....		Islám Sháh.
930	....			....		'Adil Sháh.
961	Aḥmad II.			....		Ibráhím Súr.
962	....			....		Humáyún.
963	....			....		Akbar.
969	Muzaffar III.			....		....
974	....			Muhammad II.		....
980	Becomes a province of Dehlí.			....		....

Ghiásu-d-dín Muḥammad Karím Sháh.

I. Æ 65 64 grains. No mint. 855 H.

غیاث الدینا || و الدین

... محمد شاه || سلطان ٨٥٥

Compare Thomas, page 353.

II. Æ 70 140 grains.

8(5) 2 H.

... سلطان الاعظم || غیاث الدینا
و الدین... ابراهيم محمد || محمد شاه || السلطان
٨ [٥] ٢

III. Æ 65 72 grains.

853 H.

غیاث الدینا || و الدین

سلطان || محمد ٣ شاه || ٨٥

Mahmúd Sháh I.

IV. R 80 165 grains : (?) Aḥmadábád. 911 H.

السلطان || الاعظم || ابوالفتح
ناصر الدینا و الدینالسلطان || شاه شاه || محمود
بن محمد

.. .. || ذید عمر .. margin

..... || ٩١١

V. R 65 88 grains.

The same as No. IV, but without margin.

VI. R 70 87 grains. Aḥmadábád. 900 H.

Obv. same as No. IV.

السلطان || محمود شاه || In lozenge

.. مغرب محمد اباد margin

[عروحا با نانه] سنة ٩٠٠

- VII. R 70 85 grains. Ahmadábád. 903 H.
 Obv. same as No. IV. In lozenge السلطان || محمود شاه
 margin [مر .. مر] ضرب محمد اباد [عروجانانہ] ۹۰۳
 909 H.
- VIII. R 70 88 grains.
 Obv. as No. IV, with 909 H. Rev., variety of No. IV.
- Ditto. R 50 42 grains. No date or mint Mr. Furdoonjee.
- IX. R 70 146 grains. No mint. [8]64, [8]67 H. Ditto.
 ناصرالدنيا || والدين ابو || الفتح محمود شاه || بن محمد شاه ||
 السلطان ۹۱۴ [۸]
- X. R 70 173 grains. No mint. (8)70 H. Ditto.
 Obv. as No. IX. In circle السلطان || محمود شاه
 margin سبعين واما نما
- XI. Æ 85 250 grains. Ditto.
 توكل على || الحنان البنان محمود شاه || بن محمد شاه
 ۰۰۰ بول ... ۰۰۰ ي سلطان
- XII. Æ 85 245 grains.
 ۰۰ لمؤيد بنصر [الله] اله ... ۰۰۰ سليم الله || لسلطان || محمود ۰۰۰
 ۰۰ بولغا ... ۰۰۰ ي
- XIII. Æ 75 160 grains.
 ۰۰۰ لمؤيد بنصر [الله] اله ... ۰۰۰ محمود ش .. || بن محمد ش ..
 ۰۰۰ [سلطان] ...
- XIV. Æ 65 140 grains.
 ۰۰ لسلطان الاعظ . || ناصر الدنيا ۰۰۰ بوالفتح || محمود شاه || [السلطان]
 [والدين] ||

Muzaffar Sháh II.

- XV. Æ 70 169 grains. 929 H. Mr. Furdoonjee
 ش .. لدنيا و ... || ۹۲۹ || ابوالنضر ... السلطان || محمود شاه || بن
 مظفر شاه
- *XVI. Æ 75 160 grains. 922 H.
 قتي شهر || ۹۲۲ || سنه .. شهر .. ۰۰۰ ..

Doubtful coins.

*XVII. Æ 65 143 grains, (?) Ahmādnagar (9) 17 H.

.. مرتضى || احمد [نلر] .. في شهر || سنة || ١٧ [٩]

Bahádur Sháh.

XVIII. Æ 75 175 grains.

939 H.

.. م .. لدنيا ... لد .. ين ١٣٤

السلطان || مظفر شاه || بن || بهادر

.. ل .. ظ .. ف ..

شاه

Compare No. 427, British Museum Catalogue.

Mahmád Sháh III.

XIX. Æ 80 180 grains.

Mr. Furdoonjee.

.. ا .. با [الله] .. ا ..

[السلطان] شاه شا .. || [محمود]

.. ل .. ا ..

.. لطيف || اوراج

XX. Æ 70 142 grains.

Ditto.

... صر الدنيا || والدين ابو ||

محمود بن || لطيف شاه || السلطان

XXI. Æ 80 159 grains.

945 H. Ditto.

.... قطب الدنيا والدين || ابو الفضل

السلطان || شاه شاه || محمود [شاه]

١٣٥

بن لطيف

XXII. Æ 70 137 grains.

960 H. Ditto.

.. و .. ثق .. لم .. اسف ..

.. لسلطان || شاه شاه || محمود

|| لدنيا و الدين ابو

بن لطيف ٩٦٥

XXIII. Æ 55 69 grains.

السلطان || شاه شاه || محمود بن

الوائق بالله المان || .. مس

.. ل .. ا .. ا .. ا .. ا ..

لطيف

XXIV. Æ 55 71 grains.

957 H.

.. م .. لدنيا || ٩٥٧ || .. لدین

شاه || محمود

Ahmad Sháh II.

XXV. Æ 85 164 grains.

961 H.

الرحمن بالله || ابو الحامد المصنم

In double Shah Shah || عهد السلطان

|| الذنبا و الدين || غياث

lozenge

٩٦٩ || احمد بن محمود

XXVI. \mathcal{A} 55 73 grains. 968 H. Mr. Furdoonjee.
 نيا سلطان شاه حـ ..
 بن محمد
 والدين ابو...

XXVII. \mathcal{A} 70 140 grains. **2. *63. Ditto.
 ... الخليفة امير المؤمنين || والدين احمد ...
 سلطان
 خلاف

Muhammad Sháh (?) Pretender.

XXVIII. \mathcal{A} 70 144 grains. *63. Ditto.
 ناصر الدنيا و || لدین ابو الفتح ... [ان قطب ... || بن محمد شاه ||
 سلطان
 محمد ود ...

Compare copper coins 437—9 in B. M. Catalogue.

Muzaffar Sháh III.

XXIX. \mathcal{A} 60 73 grains. 978
 المؤيد بن ... الرحمة ... || شاه ... مظفر

XXX. \mathcal{A} 70 73 grains. 97*.
 Obv. Inscription as No. XXIX. ... سلطان مظفر شاه ||

\mathcal{A} 50 36 grains. Ditto. Mr. Furdoonjee.

XXXI. \mathcal{A} 85 175 grains. 991 H. Ditto.
 In square لاله الاله || محمد مظفر
 شاه || سلطان
 margin الرحمة
 مظفر

XXXII. \mathcal{A} 75 179 grains. 977 H.
 شمس الدنيا || والدين ... مظفر شاه

Muhammad Sháh II., Bahmaní. [doonjee.

XXXIII. \mathcal{A} 95 166 grains. (?) Ahsanábád. x77. Mr. Fur-
 ... [باله]

 margin

Maḥmúd Sháh II., Bahmaní.

XXXIV. ♂ 70 146 grains.

المريد || بنصر

... || محمور... بنصر

Ruins and Antiquities of Rámpál. *—By ASUTOSH GUPTA, Esq., C. S.

Unlike Upper India, studded with monuments of ancient history, the Delta of the Ganges presents few places of interest to the antiquarian. Lower Bengal is generally as devoid of picturesque scenery as of objects of antiquarian interest. We have all heard of Saptagrāma and Suvarṇa-kāragrāma and their once flourishing commerce with the West, but what remains to show their ancient greatness? No Colossus, no Forum, not even a Hindú temple. Still there are a few places here and there, such as Gauṛ and Nadiyá, which cannot fail to be of interest to the diligent antiquarian or the student of history, and Rámpál is one of them. It is not so widely known as it deserves to be. It is now a straggling hamlet, situated approximately in Lat. 23° 38' and Long. 90° 32' 10", being about four miles to the west of Munshígánj, the head-quarters of the subdivision of that name in the district of Dacca (Dháká), corresponding with the old fiscal division of Vikrámpur. It was the seat of the old Sen kings of Bengal, and notably of Ballál Sen, whose name has been handed down to posterity as the founder of Kulinism in Bengal.

Such is the case with Rámpál and the dynasty that reigned here. The ruins, as the sequel will show, are not so important and interesting as in Gauṛ and a few other places in Bengal. But there is abundant evidence to show that Rámpál was once a royal city. The large Rámpál Dighí or the artificial lake of Rámpál, the huge mound, to which tradition points as the Bári or the palace of Ballál Sen, the very broad roads and the existence of innumerable bricks which can be found buried under the earth wherever you dig in Rámpál and its environs, are unmistakeable indications of a ruined city of palaces. Old bricks of small size were found in such abundance in and around Rámpál, that they were carried in vast quantities to 'Dacca for build-

* [Compare with this paper General Sir A. Cunningham's account of the same sites and legends, in his *Archæological Survey Reports*, vol. XV, pp. 132—135. The two accounts differ in some minor details. ED.]

ing purposes. Such is still the case with Gauṛ. Many stone idols of Hindú gods and goddesses have been found buried under the earth. There is a huge stone idol of Vishnu near the temple of Śiva in Aṭpará, about a mile west of Rámpál, and I have seen many smaller idols collected by a Vaishṇava in 'Abdulláhpur.

Rámpál appears to have been the only seat of the Sen kings up to the death of Ballál Sen, but the later kings of the dynasty lived at Suvarṇakáragráma, Gauṛ and Nadiyá. Suvarṇakáragráma, locally called Shonárgáon, is also in the district of Dacca, being about four miles from the existing Bandar of Baidya Bazar on the river Meghná. Lachhman Sen, son of Ballál Sen, generally lived at Gauṛ, which, according to the Muhammadan historians, he greatly embellished, and called after his name Lakhnautí or Lakshmanavatí. Nadiyá was the seat of the last Sen king of Bengal, when the Muhammadans conquered the country. It was in his time that Rámpál attained the highest pinnacle of its glory. The principal works, the ruins of which still exist in some form or other, are attributed to him. Rámpál seems to have been neglected, if not altogether abandoned, after the death of Ballál Sen. Lachhman Sen, his son and heir, lived principally at Gauṛ.

I now approach the solution of a problem which has already evoked much animated discussion. I mean the question of the caste of the Sen Rájás of Bengal. Before submitting my own opinion on the subject, I will briefly examine the different theories that have been advanced, and the evidence on which they are based. I have obtained much assistance from the two articles of Rájá Rájendralála Mitra on the Sen Rájás of Bengal, and the Bengali work on the same subject by Kailásh Chandra Sinha, to which Mr. Beveridge, one of the honoured members of the Asiatic Society, very kindly referred me, and also from the Bengali book by Mahimá Chandra Majumdar called 'Gauḍe Bráhmaṇ'. Three theories have been advanced about the caste of the Sen Rájás:—(1) that they were Kayasthas, (2) that they were Vaidyas or of the medical caste and (3) that they were Kshatriyas. The first theory is that of Abu-l-Faẓl and the Muhammadan historians. It is not supported by any evidence other than the statement of the Muhammadans, who are likely to hold erroneous views on the subject of Hindú castes. It was never seriously entertained by the Hindús and may be summarily rejected. The second theory is supported by tradition handed down from generation to generation not only in Vikrámpur, the old seat of the Sen Rájás, but throughout Bengal, and was universally believed, till Rájá Rájendralála Mitra in 1865 tried to establish that the Senas were Kshatriyas. This third theory is the most recent one. It was first propounded by Rájá Rájendralála Mitra, a very high

authority in matters antiquarian and supported by others. It is based on some epithets of the Sen kings found in the inscriptions discovered in Rājshāhī, Dinājpur and Baqarganj, and also in the Sanskrit work Dānasāgara of which Ballāl Sen himself is the reputed author. These I will consider in the two following paragraphs.

Tradition must give place to reliable material evidence if the one is really inconsistent with the other; but before discarding a universal belief, the evidence should be most carefully interpreted. The evidence on which the theory of the Sen Rājās being Kshatriyas is based is the following. In the inscriptions, found in the districts of Dinājpur, Rājshāhī and Baqarganj, the Sen Rājās are described as descendants of the lunar race, and as only the Kshatriyas have a right to trace their descent from that race, it is held that the Senas must be Kshatriyas. In the inscription discovered by Mr. Metcalfe in Rājshāhī, Sāmanta Sen is described as a Brahma-Kshatriya. The original Sanskrit is च ब्रह्मचरियाणामजनि कुलशिरोदाम चानन्तवेनः। Dr. Mitra's rendering of ब्रह्मचरियाणां कुलशिरोदाम is 'a garland for the head of the noblest Kshatriyas.' According to him, the word ब्रह्म therefore here means 'noble' or 'exalted.' With due deference to so great an authority, I am of opinion that this meaning is not the correct one here. We have various Sanskrit words compounded with ब्रह्म such as ब्रह्मचारी, ब्रह्मराजस, ब्रह्मदैत्य, ब्रह्मवादी, ब्रह्मदण्ड, and so forth, and in all of these the word ब्रह्म retains its original radical meaning of Brahmā or Brāhmaṇa. I therefore see no reason why it should not have the same or a similar meaning in the present instance. Dr. Mitra has not assigned any reason why he takes ब्रह्म to mean 'noble,' which is certainly not the commonly accepted meaning of the term, and cannot be found in the ordinary Sanskrit dictionaries. At any rate this meaning would be a far-fetched one. The word ब्रह्मचर्य occurs in the Yajur Veda, and is explained by the annotator as meaning ब्रह्मज्ञान-चर्यवेद्ये or 'knowledge of the Brāhmaṇas or the Vedas and heroism of the Kshatriyas.' It is therefore not a caste epithet, and following the analogy, we can take ब्रह्मचरिय to mean 'a person who has the knowledge of the Brāhmaṇas or the Vedas and the heroism of the Kshatriyas,' that is, one who combines both these qualifications; and the clause in question may mean 'a garland for the head of those who have the wisdom of the Brāhmaṇas and the heroism of the Kshatriyas,' without any reference to race or caste. The word ब्रह्मराजस also occurs in Adhyaya 21, part IV, of the Vishṇu Purāṇa, and is explained by the annotator Śrīdhara Swāmin to mean 'that race from which Brāhmaṇas and Kshatriyas sprung'. The meaning seems to be obscure. The word probably means a mixed race of Brāhmaṇas and Kshatriyas—a race

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vol 58, 1889

sprung from Bráhmaṇas on the father's side and Kshatriyas on the mother's. We have it from the Mahábhárata that when the Kshatriya race was being exterminated by Paraśuráma, the women of that caste began to marry Bráhmaṇas, and Vaśiṣṭha himself is credited with having married Kshatriya women. From that time the race of pure Kshatriyas is said to have become extinct. In Adhyaya 24, part IV, of the Vishṇu Puráṇa, Maháñandi is said to be the last king of the Kshatriya race. His son Mahápadmánanda was born of a Súdra mother, and from him began the reign of Varṇasankara kings or 'kings of mixed castes.'

The above will I think be sufficient to show that Dr. Mitra's interpretation of the word Brahma-kshatriya is most probably not the correct one. I have now to consider the description of the Sen Rájás as descendants of the lunar race. It is a well-known fact that all the princes of India, whether real Kshatriyas or not, have tried to trace their descent from the solar or lunar race of that caste. Even the Rájás of Chuṭiyá Nágpur, whom Colonel Dalton very rightly thinks to be of the aboriginal Cole or Muṇḍa origin, claim to be real Rájputs, and following their lead, the inferior landholders, who are undoubtedly aboriginal Muṇḍas, are gradually setting up claims to be Hindú Rájputs. I found this process in full operation when I was in Chuṭiyá Nágpur three years ago. If the Sen kings belonged to the Sankara race or any of the mixed castes, is it not very likely that they would aspire to be Kshatriyas and trace their descent from the lunar race, and their panegyrist Umápati Dhar, a poet and a famous adept in the art of exaggeration, would exalt them into members of the race of the moon? Even now the Súdras of Bengal are looking up. Some time ago there was a movement among the Kayasthas for taking the *yajñopavíta* or 'the sacred thread,' on the assertion that they were originally Kshatriyas; and at the present moment there is a similar movement among the Suvarṇavarṇikas, who now claim to have been originally Vaiśyas.

In the Baqarganj plate, found by Mr. Prinsep, the title of Sankara Gauḍeśwara is repeatedly applied to the Sen Rájás. The word Gauḍeśwara, no doubt, means the king of Gauṛ or Bengal, but it is not easy to explain the real meaning of the word *sankara* here. It is said to be written with palatal ś. Dr. Mitra takes it to mean 'excellent,' but he has not shown any reason for assuming this meaning, which cannot be found in the ordinary Sanskrit dictionaries and is certainly not the commonly accepted import of the term. According to the dictionaries and the common usage of the word, it is, when a substantive, a synonym for Śiva or Mahádeva, and when an adjective, it means 'auspicious.' I find Mr. Prinsep translating the

phrase as 'the auspicious lord of Gaur.' 'It is well known that the Sen Rājās, at least some of them, were *Saivas*, or worshippers of Siva, and the phrase may mean 'the lord of Gaur, a worshipper of Siva (Sankara).' But none of these interpretations seem to me to be appropriate. I am of opinion that the word *śankara* here is an euphuism for *śankara*, with a dental *s*, and then it must mean a mixed race, a suggestion which has been noticed in Dr. Mitra's paper. This meaning will be a very appropriate one. Mistakes of a palatal *ś* for a dental one and *vice versa* are not uncommon in the old inscriptions, and when we remember that the inscription in question was written in the Tirhūt or Gaur type, which represents an intermediate stage of orthography between the Kuṭila and the modern Bengālī character, the commission of such an error is all the more likely. Śrīdhara Swāmin, the annotator of the Bhāgavata, mentions the commencement of kings of the Varṇa-sankara or the mixed castes in India in his time.

In his own work the Dānasāgara,* Ballāl Sen does not call the Sen dynasty Kshatriya, but applies the epithet *चक्रचरित्रचर्य*, which means 'following the practices of Kshatriyas'. So in the 6th stanza of the inscription in the copper-plate found in the Sundarbans, the epithet of *राजन्यधर्माव*, which virtually means the same thing as *चक्रचरित्रचर्य*, is applied to Lachhman Sen. It therefore appears that the Sen Rājās are never distinctly described as Kshatriyas. Does not this show that they were not pure Kshatriyas but belonged to a mixed caste? If they were Kshatriyas, why is it not so stated in unequivocal terms? There is a legend current in Vikrāmpur that Ballāl Sen was born of a Brāhmaṇa father, the river-god Brahmaputra, who visited his mother in a dream in the form of a Brāhmaṇa. Does not this indicate the mixed nature of the Sen race?

I will now briefly consider the evidence on which the theory that the Sen Rājās were Vaidyas is based. In the various *Kulapanjikas* or genealogies of the Ghaṭaks as well as in the *Laghubharata*, *Ādisūr*, Ballāl Sen, and other Rājās of the Sen family have been distinctly described as members of the Vaidya caste. It is very likely that Devatī-vra Ghaṭaka, Kavikanthahāra and other Ghaṭakas of the Varendra Brāhmaṇas, who lived about four centuries ago and composed the genealogies, knew the true caste of the Sen Rājās.

My contention is that the inscriptions of the Sen Rājās are not

* [In his *Book of Indian Eras*, p. 77, General Sir A. Cunningham ascribes this work to "Halāyudha, the spiritual adviser of Lakshmana Sena," referring as his authority to Rājā Rājendralāla Mitra, in his paper on the Sena 'kings, in the *Journal A. S. B.*, vol. XXXIV (1865), p. 137. But this is an error, Dr. Mitra there quotes a Sanskrit verse, ascribing the work to Ballāl Sen. Ed.]

inconsistent with the genealogies of the Ghatakas and are therefore not opposed to tradition. I think the inscriptions support the view that the Senas were of the Varṇa Sankara or mixed caste. Manu recognises three classes of mixed castes: (1) *Múrdhavasikta*, or those born of Bráhmaṇa fathers and Kshatriya mothers, (2) *Ambashṭha*, those of Bráhmaṇa fathers and Vaiśya mothers, who are identical with the modern Vaidyas, and (3) *Máhishya*, born of Kshatriya fathers and Vaiśya mothers. There was no practical difference between the Ambashṭhas and Máhishyas, and Vidyábhūṣaṇa, the author of *Iaghubharata*, called the Máhishyas Vaidyas. He calls Vira Sen or Adisúra, the founder of the Sen family, a Máhishya. Remembering that they were Kshatriyas on the father's side, the Máhishya or Sen Rájás of Benágal naturally traced their descent from the lunar race of Kshatriyas, and this explains the epithets in the inscriptions recently discovered. Probably the Máhishyas and Vaidyas became gradually amalgamated, and the Sen Rájás came to be regarded as Vaidyas. I am finally of opinion that the Sen Rájás were never pure Kshatriyas, nor originally Vaidyas, but were *Múrdhavasiktas* or *Máhishyas*, who were both allied to the Vaidyas. The distinction afterwards wore away, and the Senas became gradually amalgamated with the Vaidyas.

I will now proceed to describe briefly the principal ruins and objects of interest in Rámpál. I have visited them several times during my incumbency as subdivisional officer of Munshígánj, and carefully collected all the traditions and legends by which they are enlivened. First of all, I will take the Masjid of Ba-Ádam* or the mosque consecrated to the Muhammadan faqír of that name. It is a pretty large, strong, brick-built mosque with a high arched dome. The bricks are of the same small size which characterize old Muhammadan architecture. The mosque has two massive stone pillars which are apparently snatched from a Hindú temple, and which tradition identifies as the *gadás* or clubs of Ballál Sen. It is in a dilapidated state, but is worth preserving. It has a stone tablet in front which bears an Arabic inscription, a reduced facsimile of which is herewith published (see Plate V). It will be observed that it states that the mosque was built by Bádsháh Fath Sháh bin Sultán Maḥmúd in 880 Hijrí or 1475 A. D. It is therefore 414 years old. The faqír to whose memory it is dedicated died, however, in 1106 A. D., (supposing Ballál Sen to have died after a reign of forty years) or 369 years before the mosque was erected.†

* [The real name of the faqír is Bárá Ádam, of which Ba-Ádam is a mere vulgar corruption; another corruption, Bábardam, is mentioned in *Arch. Survey Rep.*, vol. XV, p. 134. Ed.]

† There is a similar mosque with a somewhat similar inscription in Qází Qazí-

There is the following legend about the death of the faqír and the fate of Ballál Sen. There lived a Muhammadan family in Kanai Chang, a village south of 'Abdulláhpur and not far from Rámpál. The master of the house had no children. One day a faqír came and begged alms of him, but he refused alms, saying, "I will give no alms, when Alláh has not given me the boon (child) for which I 'am praying so long." The faqír predicted that he would beget a child and asked him to sacrifice a bull to the altar of Alláh when his desire was fulfilled. He then went away without any alms. In course of time the man had a son born to him, but the Hindús would not allow him to sacrifice a bull. He therefore repaired to the lonely jungle, south of Kanai Chang, and secretly sacrificed a bull. Taking as much meat of the bull as he and the members of his family would be able to consume, he buried the remainder under the ground and returned home. A kite, however, snatched a morsel of the flesh from him, and another kite trying to snatch it the morsel fell down in front of Rájá Ballál Sen's palace. On enquiry the king learned the whole story and ordered the child, to commemorate whose birth the bull was sacrificed, to be brought before him and killed the next day. The Muhammadan learned the king's decree and at night escaped with his wife and child and as much property as he could carry. He fled to Arabia and, meeting Hazrat Ádam, a faqír, at Mecca, told him all that had happened. Learning that there was a country in which there was no religious toleration, and people were not at liberty to practise their own religious rites, Hazrat Ádam came to Rámpál with six or seven thousand followers. Ba-Ádam is only another name for Hazrat Ádam. He began to sacrifice bulls and cows on the spot where the mosque dedicated to him now stands. Rájá Ballál Sen sent his ultimatum, asking him either to leave the country or fight with him. The faqír chose the latter alternative, and a protracted warfare took place between his followers and the king's army. The battles were indecisive for many days, and the loss of men on both sides was heavy. At last the faqír's followers were reduced to only one hundred men. One day Rájá Ballál Sen's men, while going to the market, saw the faqír alone reading Namáj (saying his prayers). The king marched to kill the faqír at this juncture, but as he was diffident of success, he constructed, before leaving his palace, a large agnikundā or funeral pyre (literally 'a pit of fire'), which still exists in the form of a large pit, and asked the women of his household to kill themselves by throwing themselves into the fire, if he was vanquished and killed. He

bah, two miles from Rámpál. It is described in page 76 of Blochmann's Contributions to the Geography and History of Bengal, (Jour. A. S. B., vol. XLII, p. 284.) [See the note at the end of this article. Ed.]

took a pigeon in his coat and proclaimed that the bird's return to the palace without him would mean his death and serve as a signal for the females of the house to perish in the flames to save their caste and chastity. Ballál Sen came to the faqír and struck him with the sword, but the faqír was invulnerable and the sword would not cut his skin. After concluding his prayers, the faqír asked Ballál what brought him there. "To kill you," replied the king. The faqír asked him whether he would embrace the Muhammadan faith or not. The king of course answered in the negative. The faqír said: "It is so ordained that I shall die at your hands. But no sword other than my own will cut me. So take this sword and kill me." Ballál took the sword thus offered and killed the faqír at one stroke. His body was cut into two parts. His head flew to Chittagong, where there is still a prayer-house consecrated to him. His body was buried at Rámpál, and the mosque was subsequently erected over his remains by the Bádsháh after the Muhammadan conquest of Bengal. After the death of the faqír, Ballál went to the tank to bathe and purify himself. As he left his gory clothes on the bank, the pigeon, unobserved, flew to the palace, and at this signal the females of the royal household threw themselves into the fire and perished. Soon finding that the pigeon had flown away, Ballál rode to his palace, but it was too late. Finding that all his family was killed and life was not worth living, he threw himself into the fire and perished in the flames.

Such is the legendary account of the death of Ballál Sen and the fall of Rámpál. The city appears to have been abandoned after his death, and I think there is a substratum of truth in the legend. It is a historical fact that the Arabs were the first race of Muhammadans who invaded Hindústán, and it is not unlikely that their missionary expeditions penetrated as far as Bengal in the eleventh century and fought the Sen kings who had no standing army. The Pál kings regained their ascendancy in this part of Bengal after the death of Ballál. It has been asserted, and not without some show of reason, that Lakshmaníya, after his flight from Nadiyá, took refuge in old Vikrámpur, and he and some of his descendants lived in Rámpál or Sunárgáon, and maintained their sway in this part of Bengal during the early years of Muhammadan rule. It is mentioned in the Bengali book on the Sen Rájás of Bengal by Kailash Chandra Sinha, that probably there was a second Ballál Sen who reigned after the Muhammadan conquest. It first struck me that if there was a second Ballál Sen, he must be the prince who reigned at Rámpál and killed the faqír Ba-Adam and afterwards himself perished in the funeral pyre, thereby putting an end to the Sen dynasty. But the theory is not based on any reliable evidence, while tradition distinctly says that the Ballál Sen who killed the faqír

was the founder of Kulinism and the most distinguished prince of the Sen dynasty.

The next object of importance is the Rámpál Dighí* or the artificial lake of Rámpál. Formerly it was about a mile long and about 500 yards broad. It is now fast silting up and remains dry for nearly half the year. Cultivators have now broken up parts of the lake and grow *boro* paddy in it. The following is the traditional account of the origin of the lake. Rájá Ballál Sen 'once' promised to excavate a lake, as long as his mother would be able to walk in one direction without stopping, and this he undertook to do in one night, namely, the night immediately following the pedestrian performance of his mother. So one afternoon the queen-mother walked out of the palace and proceeded towards the south. After she had walked some distance, the idea suddenly crossed the king's mind, that if she walked much further, he would be unable to cut such a large lake in one night and keep his word, and if he once broke the promise he made to his mother, he would be doomed to eternal hell. After a short reflection he hit upon a dexterous device. He asked his servants to suddenly touch his mother's feet and paint them with red pigment (*alaktuka*), giving out that a leech bit her and was sucking blood. The servants did so, and the stratagem had the desired effect. The queen-mother stopped, and the point whence she returned homewards became the southernmost boundary of the lake. On that very night the king collected innumerable men and excavated the whole lake. It was so large that one bank was not visible from the other. But for a long time the lake remained dry. Guided by a dream, Rámpál, an intimate friend and, according to another account, maternal uncle of Ballál Sen, one day rode into the lake, and assembling a large number of men on its banks, asked them to call it after his name, when it was filled with water. As soon as he entered into the lake, water streamed up from beneath and filled it in a moment. But Rámpál vanished. Everybody cried: 'Rámpál, Rámpál,' but he could no more be seen. Since that time the lake is called Rámpál Dighí.

This explanation of the genesis of the lake's name never satisfied me. Rámpál is also the name of Ballál Sen's city. Is it not very strange that Ballál's city and the largest lake he excavated should be named after an obscure person unknown to history? Rámpál is certainly the name of a person and is analogous to the names of Blím Pál and other Pál kings of Bengal. I conjecture that he was a king of the Pál dynasty which reigned at Rámpál after the death of Ballál Sen, and that it was he and not Ballál who excavated the lake, and the city and the lake have been named after him. To the north of the Búrhí-

* Rámpál Dighí or the artificial lake of Rámpál.

Gangá there are still many ruins to show that the Pál kings reigned in that part of Bengal, and it is a historical fact that they flourished both before and after the Sen dynasty. But as they were Buddhists ruling over a population, the mass of which were Hindús, their names have not been handed down to posterity with that halo of glory which surrounds the Sen kings, who were orthodox Hindús and great patrons of Bráhmans and Brahmanical learning. Again, it is a well known fact that one of the characteristics of the Pál kings was to excavate large lakes and tanks wherever they lived. The Mahipál Dighí, still existing in Dinájpur, is perhaps the largest lake they cut in Bengal. For all these reasons I am of opinion that the prince who gave his name to the city and lake of Rámpál was a king of the Pál dynasty.

There is another but smaller lake in Rámpál. It is called the Kodál-dhoá (the spade-washing) Dighí. It is about 700 cubits by 500 cubits, and is still very deep. Tradition has it that when the excavation of the Rámpál Dighí was over, each digger scooped out a spadeful of earth from a place close by, and thus the Kodál-dhoá Dighí was made. The story of course is fiction pure and simple, invented to show that myriads of men were engaged to excavate the Rámpál Dighí.

The next object of interest is Bári Ballál Sen or Ballál Sen's palace. It is a very large and high mound of earth, surrounded by a deep moat, about 400 yards by 500 yards. No architectural remains are visible. The cicerones point to a large black pit inside the ruins as the Agnikunḍa or funeral pyre in which perished Ballál Sen and his family.

Another object of interest in Rámpál is the everlasting Gajariyá tree. It is a large living tree standing on the north bank of Rámpál Dighí. It is about 100 cubits high and has two large straight stems. Trees of this species abound in this part of Bengal, and there is nothing peculiar in its appearance: only it shows no signs of age or decay, though it is undoubtedly very old. It is said to be immortal and existing from the time of Ballál Sen. Respectable men of seventy and eighty years of age, whose testimony I am unable to disbelieve, have told me that they saw the tree in its present state of growth from their very boyhood. The tree is certainly a botanical curiosity. It is held in high veneration by the Hindús, and various stories are current about its virtues and sanctity. It is worshipped by the women, particularly by the barren ones, who besmear it with oil and vermilion in hopes of being cured of barrenness. A faqír is said to have violated its sanctity by cutting a root, but he instantly vomited blood and died. No one would now venture to tear a leaf or lop off a branch. A small fair is annually held under the sacred tree on the eighth day of the moon in the month of

Chaitra, when it is worshipped by pilgrims from various parts of the subdivision.

The following legend explains the origin of the Gajariyá tree's immortality. It was at first in a decayed state and was used for tying Ballál Sen's elephants. One morning some hermits (Rishis) presented themselves before Ballál Sen's gate to confer a boon on the king as a reward for his piety. They sent their message to the king by his door-keeper. The man went in and returning said that the king was smoking and was unable to come out that instant. After awhile he was again sent in. This time he returned with the news that the king was besmearing his body with oil. The door-keeper was sent in again and again, but he always returned with some excuse or other for the king's inability to come out and receive them. Once the man found the king bathing, and again taking his noontide meal, and the third time taking his siesta. He never communicated the message to the king, but only went in to observe whether he had leisure to come out. Disgusted with the king, the hermits left the palace, but at the time of departure they blessed the Gajariyá tree and conferred on it the boon of immortality which was originally intended for the king. Instantly the tree showed signs of vitality. Leaves and blossoms sprouted forth in every direction, and the people were struck with awe. The king came out shortly afterwards and, being apprised of the news, immediately sent for the hermits. But it was too late. The hermits had vanished.

There is a comparatively small tank in the south-west part of Rámpál, which deserves a passing notice. It is called Rájá Haris Chandra's Dighí. It is overgrown with trees and shrubs which are flooded over with water for a week once a year at the time of the full moon in the month of Mágh. Before and after this period the tank is dry. I have as yet received no satisfactory explanation of the phenomenon. The tank is said to have been excavated by Rájá Haris Chandra, probably one of the kings of the Pál dynasty.

There is a mosque called Qází's Masjid not far from Ba-Adam's. It is an ordinary plain-looking prayer mosque, which was certainly erected after that of Ba-Adam. It boasts of no inscription, but has several stone idols of Hindú gods and goddesses in its verandah, which the proprietors have evidently preserved as trophies of Islám. The present Qází of the mosque showed me a firman of the Emperor 'Álamgír, granting lands for the benefit of the institution; but I cannot vouch for its genuineness.

There are two roads the construction of which is attributed to Ballál Sen. The one connects the river Dhaleswarí on the north with the Padma on the south, and the other goes in a different direction from

Rámpál right up to the Padma. The latter is called Kachkí Dwarja. The roads are now overgrown with trees and shrubs, and have in many places been broken up by the cultivators' plough, but what still remains clearly shows that they were once spacious roads as wide as thirty cubits. I once proposed to utilize the first mentioned road in constructing one from Munshiganj to the Police outpost at Rájabári, a distance of about twelve miles, but it was found impracticable. The Kachkí Dwarjā is named after the fish of that name. The astrologers had predicted, so the story runs, that Rájá Ballál Sen would die of bones of fish sticking in his throat. To avoid such an unnatural and painful death, the king refrained from eating any fish, except the kachkí which was devoid of bones. He therefore constructed the road to the Padma, to enable fishermen to supply his table daily with the boneless fish.

[NOTE BY THE EDITOR.—The inscription, of which a reduced facsimile, based on three ink impressions, is published in Plate V, reads as follows :

Line 1 :—قَالَ اللَّهُ تَعَالَىٰ وَأَنَّ الْمَسَاجِدَ لِلَّهِ فَلَا تَدْعُوا مَعَ اللَّهِ أَحَدًا قَالَ النَّبِيُّ صَلَّى
اللَّهُ عَلَيْهِ وَسَلَّمَ مَنْ بَنِيَ مَسْجِدًا فِي الدُّنْيَا بَنِيَ اللَّهُ لَهُ قَصْرًا فِي الْجَنَّةِ بَنِيَ هَذَا الْمَسْجِدَ

Line 2 :—الْجَامِع الْمَلِكِ الْمَعْظُمِ مَلِكِ كَاذُورِ فِي زَمَانِ السُّلْطَانِ ابْنِ السُّلْطَانِ جَلَّالِ
الدُّنْيَا وَالدِّينِ أَبُو الْمَظْفَرِ فَتْحُ شَاهِ السُّلْطَانِ ابْنِ مُحَمَّدٍ شَاهِ السُّلْطَانِ فِي تَارِيخِ أَوْسَطِ شَهْرِ
رَجَبِ سَنَةِ ثَمَانِينَ وَ ثَمَانِينَ

It is dated "in the middle of the month of Rajab in the year 888 A. H., during the reign of Jalálu-d-dín Fath Sháh." Mr. Gupta reads the date as "the 2nd day of Rajab 880," on the authority of a Maulawí of Dacca, who deciphered the inscription for him. But this is certainly wrong. The date can be quite clearly read. It is expressed in words : above سنة *sanat* there is ثَمَانِينَ *samánín* ; by the side of *sanat*, to the left, there is ثَمَانِينَ *samánín* ; above *samánín* again is ثَمَانِيَةَ *samanamiyat* (sic) ; below the latter word is one وَ *waw*, and below *samánín* is the other وَ *waw* of the date. Thus the whole reads *sanat samá wa samánín wa samánamiyat*, i. e., eight and eighty and eight hundred. Nor does the date specify "the 2nd day," but simply says أَوْسَطِ *ausaṭ* or "the middle."

On comparing this inscription with that published by Blochmann in this Journal for 1873, Vol. XLII, p. 284, there can be no doubt that the two inscriptions are identical. There are, indeed, three slight divergences. In the date Mr. Blochmann reads ثَمَانِينَ but the inscription has only ثَمَانِ (without the final *nūn*). This is apparently a mere blunder

of the engraver, who seems to have forgotten to incise it. Possibly the wrong reading of the date as 880 may have been caused by this faulty legend. He also reads ثمانية whereas in the inscription the word is really spelt ثمانية (without the first *alif*). Again Mr. Blochmann reads الله له قصرًا في الله له مثله في الله whereas the inscription really has الله له قصرًا في الله له مثله في الله. But there can be no doubt that these three divergences are the mere result of an oversight. As may be seen by referring to the numerous similar inscriptions, published by Blochmann in vol. XLII of the Journal, it is the word قصرًا (not مثله) that is uniformly used in them; and there is no difficulty in recognising it on the facsimile of the present inscription.

Mr. Gupta, in his footnote (pp. 17, 18) says: "There is a similar mosque with a somewhat similar inscription in Qází Qaşbah, two miles from Rámpál," and he is disposed to identify this inscription with that published by Blochmann. This identification is quite untenable. I have obtained four impressions of this second inscription, three through Mr. Gupta, and one through Maulawí Abul Khair Muḥammad Siddiq, the Superintendent of the Dacca Madrasah. Unfortunately the inscription is too badly preserved to be wholly read, but luckily the date is sufficiently legible to show that the month is Zi-l-Qa'dah, and that the year is expressed in figures as well as in words. The figures are 976. This is quite sufficient to preclude the identification of this inscription with that published by Blochmann. Moreover this inscription is incised in three lines, while that of the Ádam Shahíd mosque, published by Blochmann and now republished by Mr. Gupta, occupies only two lines. In fact, Mr. Gupta was misled by an error in Blochmann's account, or rather by an error of Dr. Wise, whose account Blochmann quotes. Dr. Wise says that "the Masjid of Ádam Shahíd is in Bikrámpur, at a village, called Qází Qaşbah, within two miles of Balálbárf, the residence of Ballál Sen." But this is quite wrong; the mosque is not "two miles from the Balálbárf," but only "about half a mile to the north of it," as General Sir A. Cunningham, from whom Blochmann received the inscription, distinctly states (see his *Arch. Surv. Rep.*, Vol. XV, p. 134). It, therefore, occupies the precise position described by Mr. Gupta. Dr. Wise, in his account,—it is clear,—confused two mosques, one of Ádam Shahíd at Rámpál, and another placed by him and Mr. Gupta at Qází Qaşbah. The exact locality of the latter mosque, however, would seem to be the Rikábf Bazár, to judge from Maulawí Abul Khair's letter, quoted below. There are four mosques in or near Qází Qaşbah, and these four mosques seem to have been more or less confused by the several writers on the subject: and the confusion probably arose from the circumstance that Qází Qaşbah is a name applied to a large area, apparently including the localities of all four mosques.

In order to clear up the matter as much as possible, Maulawí Abul Khair, at my request, was good enough personally to visit the different localities and himself procure impressions of the two inscriptions. I subjoin the substance of his interesting letter.

"As arranged I went yesterday to Munshiganj to see the mosque at Qází Qaşbah. I took with me as my guide a man who proved to be not so well acquainted with the locality as I expected. He had informed me that there was another old mosque at Rikábíbazár [No. I] which was close to the *ghát* where we were to land from the steamer. We landed at about 11 O'Cl. and proceeded to the latter mosque. We found it to be in a dilapidated condition, though there were signs of its being used as a prayer-house. It appeared to have been an edifice of elegant structure with a floor, 15 cubits square, and one dome. The bricks are all polished and carved, and the corners and edges are so neat that from a distance they seem to be stones. The cement used is a whitish substance, not ordinary súrkhí and lime, but perhaps powdered stone and lime, or something else. There was no inscription in the mosque, but on enquiry we learnt that the stone was removed and placed in another mosque [No. II] in the neighbourhood recently built. There we repaired and found the inscription. The stone not being good many of the letters are corroded, and are not decipherable. I have taken an impression, however, which I send to you in a separate cover for whatever use you may think fit to make of it. It is dated seven hundred and odd, which I could not read. The name of the month is Zi-l-Qa'dah.

"We then proceeded towards Qází Qaşbah, and after a tedious journey reached the mosque [No. III]. My disappointment was great when I found that the mosque, though old, did not present any interesting feature, the construction being of an ordinary type, no ornamentation or elegance having been attempted. Besides there was no inscription; the stone I was informed had been removed by the Collector of Dacca, during the proceeding of a lawsuit between rival claimants to some land belonging to the mosque. The only interesting thing that we found there was a Hindú idol, carved out of a block of stone, lying with the face downward and forming a step to the verandah of the mosque. I had become so fatigued that I feared I would not be able to return to the *ghát* without some sort of conveyance. But none was available. I was, however, informed that the route we had taken was a circuitous one, and that the *ghát* would not be very far from that place by a short-cut through Rámpál. I further learnt that we would pass by the mosque of Bárá Ádam [No. IV]. This news somewhat enlivened me, and I was on my legs again. We passed by the famous Ballálbári, of which I saw the ditch about a hundred yards wide. The Ballálbári or palace of

Ballál Sen seems to have been an entrenched fortress of which only the trench and some ruins now remain as a memorial. Not far from this I found the tomb of Adam Shahíd or Bába Adam and the mosque [No. IV]. This edifice is also in ruins, but presents an interesting view to the archæologist or antiquary. The structure is of the same style as that of the mosque at Rikábíbazár [No. I], but more exquisite and ornamental. The cement is of the same nature, the bricks polished and carved. The roof consists of six domes supported by two stone pillars in the middle of the hall. One of the domes does not exist, and another has partly fallen down. The pillars are monoliths of a whitish stone, which always "perspire," and lead ignorant people to associate superstitious ideas with them, as they see water flow down on their surface, and feel them very cold. I saw marks of red pigment on the pillars, which I heard were put there by Hindú women, (and I believe by Musalmán women too, though the Khádím denied this) on making vows for the attainment of some object. The stone bearing the inscription is placed very high, so that it could not be distinctly read. I discovered, however, that the copy I have sent to you was only of one line, there being another line above it of which no impression was sent to me. As it was already very late in the afternoon and I could not wait for a scaffolding being put up, I could not obtain an impression. The inscription published by Blochmann is, I believe, of this mosque, and he was not very wrong in giving the name of the place as Qázi Qaşbah; for Qázi Qaşbah extends over a large area, and the place where this mosque stands is also included within it. This fact decides the dispute as to the name of the place being given by Blochmann as Qázi Qaşbah and by Bábu Asutosh Gupta as Rámpál. It may be called by four different names, viz., Qázi Qaşbah, Rámpál, Ballálbári and Durgábári. The inscription is quite legible, no letters have been destroyed or mutilated, the stone being jet black and well polished, not liable to corrosion. The Khádíms showed me twelve places in the interior of the mosque, where, they said, lay twelve stones of great value which were removed by Mags during an incursion into Bengal in remote ages. These stones, they said, shone in the darkness of the night and illuminated the hall! Some things have been dug out of the walls, no doubt, but whether they were stones of great value which shone in darkness I cannot vouch. This mosque at any rate is an object of interest to the antiquarian."

From another letter of his, I may quote the following passages:

"The mosque at Qázi Qaşbah [No. III] is not known as the mosque of Bába Adam or Adam Shahíd. It is called Qázi Bári mosque. Ballálbári is situated near the mosque [No. II] of Adam Shahíd and not near Qázi Qaşbah; and Ballál Bári and Rámpál are only two names of the

same place. There is no one's tomb near the mosque of Qází Qaşbah. As for the inscription, no one can say what it contained. The other mosque, of course, is called after Bába Adam or Adam Shahíd and is situated in Durgábárá, which is close to Rámpál or Ballálbárá, at a distance of about half a mile. And Ballálbárá and Durgábárá both stand at a distance of a mile from Qází Qaşbah. The tomb and the mosque are lying unrepared. Some religious man has the charge of the mosque, and prayers are said therein. The mosque has two domes between which there are two stone pillars one on each side. There is no courtyard outside the mosque. The mosque of Qází Qaşbah [No. III] also has two domes but no courtyard and pillars. There are stones at the threshold carved into images and placed overturned."

I have numbered the mosques in the above quoted extracts by corresponding numerals.

No. I. Mosque of Rikábí Bazár; a beautiful structure, similar to the mosque of Adam Shahíd at Rámpál (No. IV); with only one dome; its inscription, dated in the month Zi-l-Qa'dah 976 A. H., removed to mosque No. II. It is the mosque referred to in Mr. Gupta's footnote (p. 17), as situated "in Qází Qaşbah, two miles from Rámpál;" it is also apparently the mosque, said by Dr. White to be "within two miles of Ballálbárá at a village called Qází Qaşbah" and erroneously called by him the Adam Shahíd mosque (No. IV).

No. II. A mosque recently built near mosque No. I; contains the inscription belonging to No. I.

No. III. An ordinary plain mosque, with domes, but with no pillars, also with Hindú carved images in the floor of the verandah; its inscription removed to Dacca; referred to by Mr. Gupta towards the end of his paper (p. 22).

No. IV. Mosque of Adam Shahíd, close to Rámpál, at the distance of about half a mile; a highly ornamental structure, resembling the Rikábí Bazár mosque (No. I); with the inscription (Plate V) dated "in the middle of Rajab, 888 A. H., in the reign of Jalálu-d-dín Fath Sháh;" described by Dr. White (quoted by Blochmann) in *Journal A. S. B.*, Vol. XLII, p. 285, General Sir A. Cunningham in *Arch. Survey Reports*, Vol. XV, p. 135, and Maulawí Abul Khair, as possessing *six* domes, of which, according to Dr. White, *three*, but according to Maulawí Abul Khair only *two* have fallen in, while General Sir A. Cunningham does not notice the destruction of any of them. On the other hand, Mr. Gupta, who describes it as a "brick built mosque with a high arched dome," would seem to allow it only *one* dome. In that case, he would seem to have confused it with the mosque (No. I) at Rikábí Bazár, which Maulawí Abul Khair states to have only one dome.]

The Namuchi-myth; or an attempt to explain the text of R̥gveda viii.

14. 13.—By CHARLES R. LANMAN, Professor in Harvard College, Cambridge, Mass., U. S. A.

The fact has been recognized, ever since the earliest days of Vedic study, that the myths of the Veda are the poetic outgrowth of certain natural phenomena. The fact appears, for example, from the work of Yāska, when he quotes the opinion of his predecessors. And the natural basis of any given myth is usually not difficult to ascertain. Such, however, is not the case with the one now in question. The text cited above reads :

अपां केनेन नमूचेः

शिर इन्द्रोद्वर्तयः ।

विद्धा यदजय स्युधः ॥

It is commonly understood and rendered as follows: 'With the foam of the waters, Namuchi's head, O Indra, thou didst cut off, when thou wast conquering all thy foes.'

There is no doubt about the incorrectness of this interpretation. Nevertheless it is an exceedingly ancient one, as appears from the legends into which this brief allusion of the Vedic Samhitā is expanded in the Brāhmaṇas. From the Brāhmaṇa-passages* and from the explicit language of Śāyaṇa†, it is clear that the water-foam was conceived as the actual weapon with which Indra cut off the demon's head. The fable says that Indra used this most remarkable weapon because he had sworn to Namuchi, saying, "Neither by day nor by night will I slay thee, neither with the mace nor with the bow, ... neither with the dry nor with the wet." And so, in order to slay him, without perjuring himself, Indra smote the demon at twilight, which was neither day nor night, and with the foam of the water, which was neither dry nor wet. 'He cast the water-foam into (the shape of) a thunderbolt'—अपां केनेन वज्रमसिद्धम्—literally, 'The water-foam he made by pouring or founding (as molten metal) to be a bolt.'

All this is quite in keeping with the style of the Brāhmaṇas; and it follows naturally enough from the text of the Samhitā, provided we misunderstand it as did the authors of the Brāhmaṇas. But to my mind there is no conceivable natural phenomenon of which this may be re-

* See Śatapatha Br., xii. 7. 3; Tāittirīya Br., i. 7. 1. These passages, with one from the Mahābhārata, are conveniently assembled by Muir, in his *Sanskrit Texts*, iv^o. 261.

† केनेन तस्य शिरसिन्द्रेद...अपां केनेन वज्रीभूतेन ॥

garded as the mythical reflex. We are therefore led to inquire, did not the words of the sacred text mean something different from what even the ancients themselves supposed them to mean? I believe that they did and that the misunderstanding can be accounted for.

I suggest that the Vedic text be translated: 'With water-foam Namuchi's head, O Indra, thou didst cause to fly asunder, when thou wast conquering all thy foes.' This appears to me intelligible if we assume that the natural phenomenon to which it refers is a waterspout ('*trombe*') on an inland lake. How, now, does this view accord with the natural facts in question and with a strict verbal exegesis of the text?

Major Sherwill has given a description of Bengal waterspouts in the Journal of this Society for 1860, volume XXIX., p. 366 f., along with some excellent pictures. And in a German work of Th. Reye, entitled *Die Wirbelstürme*, p. 17 f., further information and pictorial illustration may be found. The waterspout is of course an object of terror, and it is most natural that it should be personified as a demon. The verb *वर्तयितुम्* means 'cause to rotate,' and the motion is qualified as upward and outward motion by the preposition *उद्*. The compound *उद्वर्तयः* means accordingly, 'thou didst cause to move upward and outward or to fly asunder with a gyratory or centrifugal motion.' It is not possible to express by one simple English phrase the ideas involved in the compound; but they seem to me to be quite simple in themselves and to follow unforced from the Sanskrit and to be thoroughly suitable for the not infrequent phenomenon of a waterspout as seen by unscientific eyes. The head of the column is twisted and made to burst asunder and scatter itself 'with foam' (*फेनैः*, as an instrumental of accompaniment), i. e., in abundant foamy masses. Then, with the dispersion of the column, often comes (see Sherwill, p. 370; Reye, p. 32) a heavy rain. This is all in entire accord with the usual representations of gracious Indra's deeds of prowess.

In particular, also, it accords most strikingly with the quite differently expressed idea of Rigveda v. 30. 8b (= vi. 20. 6b), where Indra is spoken of as 'twirling (like a stick of attrition or like a churning-stick) the head of the demon Namuchi,'

मिरो दासस्य नमचेनैवायम् ।

and that, immediately after the couplet in stanza 7,

अना दासस्य नमचेः मिरो यद्

अवर्तयौ नमचे गागुभिश्च ।

This explanation of the stanza in question, moreover, harmonizes well with the succeeding stanza, Rigveda, viii. 14. 14,

सायामिद्विद्वत्त

इदं सायामिद्वत्तः ।

अथ दक्षिणधनुः ॥

in which Indra is praised for hurling down the demons that were striving with magic wiles to creep up and to scale the heights of heaven. To the poetic fancy, nothing would suggest more naturally the idea of demons trying to scale the heavens than the sight of this strange magical ladder betwixt earth and sky.

In this connection, the discussion of Bergaigne, *La religion védique*, ii. 346-7, should be compared. The language of the śloka at Mahābhārata, v. 10. 37 = 328 seems also to favor my view. The whole epic passage is a reminiscence of the Namuchi-story.

The false interpretation of the ancients, finally, rests simply upon the ambiguity of the instrumental case form *केन*. The case might denote the relation of accompaniment—as it really does here; or it might denote the relation of means—as the authors of the Brāhmaṇas supposed it to do.

On some new or rare Muhammadan and Hindú Coins.—By

DR. A. F. RUDOLF HOERNLE.

In July and September last I received from the Deputy Commissioner of Hoshangābād, in two instalments, a hoard of 477 gold coins, which had been found in a field in the Sohāgpur Tahsíl of the Hoshangābād District, by some ploughmen while ploughing their field.

This hoard was carefully examined by me, and a detailed report published in the *Proceedings* of the Society for December 1887.

Among the 477 coins, there were 451 belonging to different (so-called) "Pathán" emperors of Dehlí; 4 belonging to the Mughal emperors Aurangzib and Farrukh Siyar, 1 belonging to the Bengal king Sikandar bin Ilyás; and 21 silver-gilt forgeries.

The "Pathán" emperors of whom there were coins, are Ghiyásu-d-dín Balban (1 specimen), Muizzu-d-dín Kaiqobād (1), Jalálu-d-dín Fírúz (1), 'Aláu-d-dín Muḥammad (391), Ghiyásu-d-Tughlaq I. (3), Muḥammad bin Tughlaq (24), Fírúz Sháh (19), Fírúz Sháh and Fath Khán (2), Fírúz Sháh and Zafar (2), Ghiyásu-d-dín Tughlaq II. (2), Abú Bakr bin Zafar (1), Muḥammad bin Fírúz (1), Maḥmúd bin Muḥammad bin Fírúz (1), and Maḥmúd bin Muḥammad bin Tughlaq (1).

Most of these coins belong to more or less well-known types, which have been already published in Thomas' *Chronicles of the Pathán Kings*

of *Dehli*. See details in the report above referred to. It will be seen from that report, that in the present hoard there are several types of coins which were still noted as "unique" in Thomas' book; e. g., the coin of Jalálu-d-din Fīrūz (Chron. No. 120), several of Muḥammad bin Tughlaq (Chron. Nos. 172, 179), one of Fīrūz Shāh (Chron. No. 226), one of Fīrūz Shāh and Zafar (Chron. No. 245). There are in it also some coins, which are not to be found in Thomas' *Chronicles*, though they have been published elsewhere: thus two of Maḥmūd bin Muḥammad bin Fīrūz (with *Abu-l-Muḡaffar*, as published by myself, in this Journal, vol. LII, p. 213, for 1883), and one of Maḥmūd bin Muḥammad bin Tughlaq (published by Mr. Delmerić in this Journal, vol. XLIII, p. 97, for 1874).

The most important in this collection of "Pathān" coins, however, are five, which, to the best of my knowledge, are unique, or at least have never been noticed or published. These are the following (see Plate IV):

1, One coin of Muḥammad bin Tughlaq (Plate IV, No. 1). It reads as follows:

Obv.

Rev.

الحاكم ناصر الله

ابو العباس احمد

The reverse seems to bear a date, consisting of two numerals. One of them, 5, is distinctly seen by the side of *abū*; but the other above the *s* of 'Abbās is obscure. As the Khalīf Abu-l-Abbās Aḥmad reigned from 741-753, the date of the coin can only be 745. This coin has some similarity with Muḥammad bin Tughlaq's copper coin, No. 218 in Thomas' *Chronicles*.

2, Two coins of Ghiyāṣu-d-dīn Tughlaq II. He is mentioned in Thomas' *Chronicles*, as the twenty-first king (A. H. 790-791 = A. D. 1388). He reigned only a few months, as the rival of Muḥammad bin Fīrūz and Abu Bakr. Thomas' *Chronicles* only notice "silver and copper" coins of his (p. 302). The present collection contains two gold coins of his, of two different types. The first (Plate IV, No. 2) reads as follows:

Obv.

Rev.

السُّلْطَانُ الْأَعْظَمُ
فِيَاثُ الدُّنْيَا وَالْدِينِفِي زَمَنِ الْأَعْلَامِ
أَمِيرُ الْمُؤْمِنِينَتَغْلُقُ شَاةَ
السُّلْطَانِيأَبِي مَبْدُودٍ
خَلَّدَتْ خَلْقَهُ

Margin: on reverse: [۷] ۹۱ دهلي

• It was struck at Delhi, in the year 791. The mint is distinct on the margin, but the date is only partially preserved. There can be no doubt, however, of its being a coin of Tughlaq II., and not of Tughlaq I., on account of the mention of the Khalif Abi 'Abdullāh. This Khalif only ascended the throne in 763 A. H., while Tughlaq I. died already in 725 A. H. Abi 'Abdullāh's Khalifat lasted, with interruptions, down to 808 A. H. This identification I owe to Mr. Chas. J. Rodgers, of the Archæological Survey, to whom I showed the coin.

The second (Pl. IV, No. 3) reads as follows :

Obv.
غياث الدنيا
والدين ناصر
امير المؤمنين

Rev.
المستول على
الله ابو المظفر
تغلق شاه

Margin, on reverse : illegible.

This coin is also shown to be one of Tughlaq II., by the mention of the Khalif Al Mutaḥakkal 'Alī Allāh, who is the same as the above mentioned Abi 'Abdullāh. The execution of this coin is rather crude, especially of the word Abu-l-Muzaffar.

3, One coin of Abū Bakr, the son of Zafar Khān and grandson of Fīrūz Shāh. He succeeded Tughlaq II., but only reigned for a little more than a year, from 791 to 792 A. H. In Thomas' *Chronicles* (p. 303) he is noticed as the twenty-second king, but only copper or silver copper coins of his are described. The present collection contains one gold coin, which reads as follows (Plate IV, No. 4) :

Obv.
السلطان الاعظم
ابو بكر شاه بن ظفر
بن فيروز شاه
السلطاني

Rev.
في زمن الامام
امير المؤمنين
ابي عبد الله
خلدني خلافتي

There are faint traces of a margin on the reverse, which probably gave the mint and date.

4, One coin of Sikandar bin Ilyās, one of the independent kings of Bengal. For some account of him, see this Journal, vol. XXXVI, p. 58, and vol. XLII, p. 256. So far as I am aware, only silver coins of his have hitherto been discovered; they have been described and figured by E. Thomas, in vol. XXXVI. The coin in the present collection is of gold, and reads as follows (Plate IV, No. 5) :

Obv.	Rev.
الإمام	يحيى خليفة
الأعظم أبو	الله ناصر أمير
المجاهد سكندر	المومنين خلد
شاه ابن ابباس	الله خلا
شاه السلطان	فنده

There was a margin on the reverse, which probably contained the mint and date, but it is quite mutilated. The readings are identical, and their arrangement nearly identical, with those on Thomas' type No. 4 (or coin, No. 22) in vol. XXXVI, p. 64. The mint, accordingly, would seem to have been Fīrūzābād.

To these five coins I add another which is not new, as it has been already described by Thomas in his *Chronicles*, p. 298. But I am not aware that it has ever been figured; and the present specimen has the further advantage of having preserved a portion of the margin on the reverse, giving the mint and date. It is a coin bearing the joint names of Fīrūz Shāh and his son Fath Khān, and reads as follows (Plate IV, No. 6) :

Obv.	Rev.
شاه	في زمان الامام
فخر الدين فيروز	امير المومنين
مد الله ظلال	ابوالفتح المعتضد الله
جلاله	خلدت خلفه

Margin : on reverse : كه في سنة احد

Fath Khān was made co-regent in 760 A. H., and the Khālif Abu-l-Fath whose name appears on the reverse, reigned from 753-763 A. H. It follows that the date of the coin, of which only the numeral 1 is preserved, must be 761. The name of the mint I am unable to read.

I take this opportunity to publish figures of two copper coins of Saifu-d-dīn al Hasan Qurlagh. They belong to the well-known "Bull and Horseman" type, already noticed by Thomas in his *Chronicles*, p. 96 (No. 82). They show on the obverse a horseman with the legend, in Nāgarī characters, श्री हमीर *S'ri Hamīrah*; and on the reverse a humped bull, also with a Nāgarī legend. The latter, as given by Thomas, is श्री हसर कुरल *S'ri Hasara Kurala*; and this is, no doubt, the style in which it is met with in by far the greater majority of specimens. But occasionally the name is found in full कुरलका *Kurlaka*. Among a number of 100 of these coins, discovered not long ago in Shāhpūr in the Panjāb, and examined by me, I found about a dozen giving the full name. (see

Proceedings for December 1888). On Plate IV, I give the reverses of four specimens (Nos. 7—10). No. 7 shows the usual form कुरल *kurala*, but No. 8 has distinctly कुरलक *kuralaka* (the क *l* is slightly injured); No. 9 reads श्री हसल कु *S'ri Hasana Ku*, and No. 10 has श्री हसल कुरल *S'ri Hasana Kurala*.

I also take this opportunity to publish two gold coins (Plate IV, fig. 11, 12) which I found among a lot of 506 coins collected by Bábú P. C. Mukherjī, on special duty with Archæological Survey, and forwarded to the Indian Museum in Calcutta. They belong to the class commonly known as 'Kanaúj coins.' Coins of this description were issued by the Kulachuri kings of Chedi, the Gaharwár (Rathor) kings of Kanaúj and the Chandel kings of Khajuraha. As the two coins, here published, are said to have been found in Khajuraha, I think it most probable that they are Chandel coins, though I feel uncertain as to their exact attribution.

No. 11—I propose to read.

श्री मत्प	<i>S'ri Māt Pa-</i>
रमर्दि	<i>ramarddi</i>
देव	<i>Deva</i>

No. 12—may be read.

श्री मद्दी	<i>S'ri Mat Vī-</i>	or	श्री मद्दी	<i>S'ri Mat Bá-</i>
रवम्मा	<i>ra Varmma*</i>		रवम्मा *	<i>la Varmma*</i>
* देवी	<i>* Devī</i>		* देवी	<i>* Devī</i>

The final long *i* of *devī* seems clear; but it is puzzling.

The king to whom No. 12 belongs, I take to be the 20th of General Sir A. Cunningham's list of Chandel kings (*Archæological Survey Reports*, Vol. XXI, p. 80), viz. Vira Varmma, who reigned from about 1240—1280 A. D. Or it might be Bála Varmma, mentioned by Mr. V. A. Smith in his paper on the "History of Bundelkhand" (*Journal*, B. A. S., Vol. L, p. 19); but he appears to have been only one of the younger scions of the regal house, and would not have been entitled to issue coins in his name.

No. 11 I take to belong to the well-known Paramárdi Deva (the 18th of Gen. Sir A. Cunningham's list), who reigned from about 1165—1203 A. D., and fought with the famous Prithví Ráj and Quṭb-d-din Aibak.

If my attributions are correct, both the coins now published would appear to be unique. For the only Chandel coins hitherto known and published, so far as I am aware, are those noticed by Gen. Sir A. Cunningham in his *Archæological Survey Reports*, Vol. X, pp. 25—27 (see his Plate X). They belong to the following five Chandel princes: Kīrti Varma (12th of the list), Hallakshana Varma (13th), Jaya Varma

1889.] Dr. Hoernle—*New or rare Muhammadan and Hindú Coins.* 35

(14th), Prithví Varma (16th), Madana Varma (17th). Then follows Paramarddi Varma (18th), a coin of whom is now published for the first time. I may note, however, that Gen. Sir A. Cunningham's coins, Nos. 15 and 16 on his Plate X (Vol. X), appear to show some resemblance to my No. 12. They too seem to read *devi*. They are marked on his Plate as "unknown."



JOURNAL

OF THE

ASIATIC SOCIETY OF BENGAL.

Part I.—HISTORY, LITERATURE, &c.

No. II.—1889.

Life of Sum-pa Khan-po, also styled Yeśes-Dpal-hbyor, the author of the Rehumig (Chronological Table).—By BĀBŪ SARAT CHANDRA DĀS, C. I. E.

This great Lama was born in the year 1702 A. D. (*Tree-monkey* of the 12th cycle of 60 years) at a place in the neighbourhood of the Dgon-luñ monastery of Amdo in ulterior Tibet. He is better known by his family name of Sum-pa, which means one from the country of Sum, a province in Western Tibet. In his infancy he is said to have given indications of his identifying himself with the spirit of his predecessor. While very young he learnt to read and write with extraordinary facility. He became well known by the name of Sumpa-Shabs-druñ. He was admitted into the monastery of Dgon-luñ in the 9th year of his age. He received instruction in the sacred literature of the Buddhists under Lchan skya Rinpo-chhe Ñag-Dvañ chhos ldan and Thu Kwan chhos kyirgya-mtsho and other great Lamas. From Lchañ-skye he received the vows of monkhood, who gave him the name Yeśes Dpal hbyor. He studied metaphysics, logic, rhetoric, poetry, Buddhist liturgy, ritual, and the dogmatical and theoretical differences of the various Buddhist schools. He also learnt arithmetic, medicine, the science of vocal music, the works on Sūtras and Tantras, and the art of sacred painting. With the acquisition of all this learning he was occupied till the twentieth year of his age. In addition to acquiring all the virtues and talents of his predecessor, he gained the highest proficiency in astronomy, astrology and the science

of figures. His fame of learning surpassed that of all other Lamas of his age in Tibet, China, and Mongolia. In the twentieth year of his age he visited Tibet proper, and took his admission as a student in the monastery of *Hbras-sPúñ* (Dapúñ). In the year 1725 he visited *Gtsañ*, where he took the final vows of monkhood from Panchhen *Blo-lsañ Yeśes*. In the 22nd year of his age he went on a pilgrimage to *Lhokha* with a view to visit *Sam-yéa*, and the famous sanctuaries of *Yar-luñ*, where he was very much pleased with an interview with *Rgya lras Rinpoche* (*Ñag Dvañ Hjigs med*). *Rgyal-sras* is said to have explained to him in a prophetic manner what he was destined to achieve and how he should proceed to *Amdo*, for the purpose of founding monasteries and temples there, and also for diffusing Buddhism in China. In his 23rd year he was appointed *MKhañpo* (abbot) of *Sgo Mañ* in *Hbras spuñ*. In the following year, when a dispute arose between the two provinces *Dvus* and *Gtsañ*, he persistently declined to allow the monks of his college to take up arms against their enemies, as it was an act prohibited by the laws of Buddhism. The monks of other colleges followed his example and desisted from fighting. He filled the chair of *Sgo-mañ* for a period of five years, after which he returned to *Amdo*. In the 30th year of his age, in pursuance of the prediction of *Rgyal-sras*, he founded the monastery of *Bshad Sgrub-gliñ* with about eighty monks. He brought the recluse hermitage of *Bsam.gtan-gliñ ri-khrod* with fifteen monks, which was founded by *Dpal lDan hod sser*, under his own monastery, and afterwards called it by the name of *Sum-pa rikrod*. At the age of thirty-four, at the command of the emperor *Chhin-luñ* (divine protector), and in the 2nd year of his reign, he visited China. Both *Lohan skya Rol-pahi rDorje* and he were presented to the emperor, who asked them many questions on religious matters. *Sumpa Khanpo* is said to have answered all of them without any difficulty whatever. Pleased with him the emperor commanded that he be appointed the spiritual guide of all the chiefs of Mongolia, and he also conferred on him a high sacerdotal rank by letters patent, and authorized him to bear the title of *Huthogtu* (saint). The Lama respectfully accepted all the imperial favours, with the exception of the title of *Huthogtu* which honour he respectfully declined, according to him it being intended for those who aspired to worldly glory. The emperor was struck with the Lama's indifference to such a high honour, and remarked that within his vast empire he did not know one who like him could look with indifference at such an exalted distinction. Henceforth he rose high in the esteem of the emperor and was declared to be a real Lama. He resided in China for nine years. The emperor occasionally used to call him to his presence. The *Lohan skya*, who presided at the head of *Labrang* (church), commanded that all

the Tibetan books on Buddhism extant in China should be revised by Sumpa, which he did to the great satisfaction of all. He therefore gave him the clerical title of Ertené (precious) Paṇḍita. He presented him with a diploma inscribed on a yellow scarf. Once on every month the emperor used to give him audience and converse with him on religious matters for several hours. He resided for five years in Peking, during which time he enjoyed the esteem and the veneration of the Manchu and the Mongol residents and the pilgrims of Peking. At the time of his return to Amdo, which he performed viâ Dolonor and Khar shonpo he received considerable presents from the emperor, Lohan-skye and the great Wangs (chiefs) of China and Mongolia. At Rivo-rtse lha (Woo-thai) he stayed one year in order to perform religious worship in the great sanctuary of Manju Ghosha. In his northward journey he visited Alaksha, receiving immense presents from the Mongols, whence he proceeded to Dgon-luñ. Being indifferent to worldly comforts, he did not like much ostentation, and consequently kept few retainers and servants. In the 43rd year of his age he was appointed to the headship of Dgon-luñ monastery. Out of the immense wealth he had acquired in China and Mongolia he used to send large presents to the Panchhen and Dalai Lamas, to the great monasteries of Sera, Hbras-spun, Dgañ ldan, Bkra sis lhunpo, &c. He also set up innumerable Buddhist images, inscriptions and *chhortens* &c. His works are voluminous and many. Being dissatisfied with the existing works on astronomy, astrology and chronology of Tibet, he wrote a dissertation on them after collating 20 works by different authors. He found the works of Mkhas-grub rje and Bu-ston to be more correct than others. He died at the age of 73. The following are his principal works:

Kun-gsal meloñ (on arithmetic, astronomy and astrology) a large volume written in very small characters.

Bdud rtsi thig-pa (drops of nectar) on medicine.

Lag-len (practice) of medicine, &c.

Sel-dkar meloñ (crystal mirror) on diagnosis.

Gso-dpyad.

Sku-garuñ thug-rtan dkyil thig tshad (structure, proportion and form of images, diagrams, symbols, &c.).

Sgra, Sñan-ñag and sslos gar (rhetoric and poetry and drama).

Rgya-Bod and Hor Chhos lbyun (Ljon-bssañ), i. e. the history of Buddhism (rise and progress of Buddhism) in India, China and Tibet. This work was completed in the year 1747 A. D., and also contains the "Reñmig (chronological table).

A work on Buddhist charms to enable men to work miracles.

Hdsamgliñ Spyi bsad (general account of the world) on the geography of the world.

. A work on Yoga.

A work on fortune telling and divination.

A work on meditation.

REHUMIG.*

(Translation.)

CYCLES†—I

A. D. 1026.

The twelfth *Kulika* emperor, called *Súrya*, ascended the throne of *Sambhala*. *Dge bés* *Fotova Rinchen gsal* was born. *Gyi-jo Lo-cháva* translated the *Kála-chakra* system of astronomy for introducing it into Tibet. The year of the Buddha's *Nirváṇa* being fixed in the year called *Fire-hare*, this year (1026) was the 361st year of the period of *Adhi-drishṭi*. According to the calculation of those who place the Buddha's death in the year *Iron-dragon*, this was the 408th year of *Adhi-drishṭi*. A. D. 1026

According to some writers the work, called *Dus-hkhor hgreḷ-chhen*, was translated in Tibet by *Gyi-jo Locháva* in the year 1027

Se-ston Kun-rigs, the spiritual teacher of *Ma-chig Sha-ma tcham Sriñ* and pupil of *hBrog-mi Lo-cháva*, was born. 1028

Phu chhuñ-va gshon-rgyan was born. 1030

Rinchen sñiñ-po of *Stod luñ*, the pupil of *Spyan-sña-va* was born. 1031

Spyan Sña-tshul khrimis hbar was born. 1032

Hkhon Dkon-mchhog rgyal-po of *Sa-skya* was born. 1033

La-chhen (*bLama Chhenpo*) *DGoñgs-pa rab gsal* proceeded to the mansion of purity (died). 1034

Râog Chhos-rDorje, the disciple of *Marpa*, was born. 1035

Jovo rje Dpal ldan Atísa arrived at *MÑah rigs*. 1038

Rje-btsun Milaras-pa was born. *Bari Lo-cháva Rinchen-grags* was born. The *Shalu* monastery was founded. *Náro Pan-chhen* died. 1039

Ye-sés hbar of *Snehu ssur*, the eldest son of *Dgonpa-pa* was born. *Mñar sgom brtson hgrus hbar* of *Smyung rum*, who was the pupil of *Spyan sna-pa*, was born. *Atísa* visited great Tibet (according to some) in the 61st year of his age.* 1041

* The italics in the proper nouns are not pronounced.

† The *Vṛhaspati* Cycle of 60 years was introduced into Tibet by the Indian Pandit *Chandra Nátha* in the year 1025 A. D.

The monastery of Myu-tu lañ was founded by Hbrogmi Lo-cháva. A. D. 1042

Machig Sha-ma's husband was born. Rma-Lo-cháva Chhos hbar of La-stod was born. HBrom met Atísa in the 41st year of his age. 1043

Hbrin Ston of Rgyal was born. Ssla-va grags-pa, the son of Lche dal sgañpa, was born.

Chhag-khri mchhog met Atísa. 1044

Rgya-hdul hdsin dwañ phyug tshul-khrims hbar was born. Atísa miraculously witnessed the religious service performed by Maitreya (Byams-pa) and Manjuśrí (Hjam-dwyañs) at sNe-thañ. 1046

Mu-dra-va founded the monastery of E-dgon. 1048

Gñal chhos hbar was born. HBrom made his first presents to Atísa. 1049

Atísa wrote his work on the Buddhist chronology. 1050

Machig Lab sgron of Kham-pa Luñ was born. Machig yumo became the pupil of Sba-sgom ye-byañ and others of the later Rñiñ-ma school. Dharma Bodhi was born. 1051

Sdiñ-po snubs Chhos-hbar was born. 1052

Edorje Senge of Glañ-ri thañ (Potova's disciple) was born.

Lama gshen, the pupil of Roñssom Locháva Chhos-bsañ, was born. } 1053

Atísa died at the age of 73.

Pá-tsha-va Locháva called Nima Grags-pa was born. Rma-sgom chhos gses of the Shi-byed school was born. Shiñ ston chhos hbar was born. The celebrated Machig Lab-Sgron was born. Rinchen bsañpo the great Locháva died. 1054

Trep mchhogs, the spiritual teacher and Mkhanpo of Rñog legs, was born. 1055

Sher-hod of Shañg Kama was born. The monastery of Rva sgreñ was founded by HBrom ston-pa. 1056

Chhag-khri-mchhog, one of the disciples of Atísa, died. 1057

Rñog Blo-ldan ses-rab was born. Dol bu ser-rgya-ma was born. Rog-dmar-shur was born. 1058

Rma-bya Rna-ra-va of rGyal was born. Sna-nam rdor dwañ of Shañ died. 1059

Machig receives spiritual instruction from A-ston. 1060

Skhor-chhuñ of Phyag chhen school was born. Ma-chig Shama, the pupil of Se-ston Kun-rigs, was born. So-chhuñ Dge-hduñ hbar of the Shi-byed school was born. Kun-dgah, the second of the Shi-byed school, was born. 1061

Se-mkhar-chhuñpa (of Lam-hbras-pa) held the monastery of Lñogm-khar-chuñ. HBrom ston died. 1063

A. D.

Rnal-hbyor Ame held the headship of *Rwa-Sgreñ*. 1064

Rgy-agar *Phyag-na* visited the *Ye-rañ* monastery in *Nepal*. 1065

Padma *byañ-chhub* of *Sa-po sgañ*, the pupil of *Phu-chhuñ-pa*, was born. *Byañ-chhub yeśes* of *Rgyal-tsha* was born.
HJam-Dpal and *Skyl khun-pa* *Hab-jo*, the two disciples of the *Grub thob Yumo*, were born. *Hdsad* *Dharma* met *Pha-dampa Sans rgyas*. *Lche-Sgom Nañ-pa* unearthed the concealed scriptural treasures of *Lche-b tsun*, the *Rñiñ-ma Lama*. 1066

Chhos *kyi Rgyal-po* of *Hkhon-phu*, the brother of *Machig Sama*, was born. 1068

Sarava *Yontan Grags*, the disciple of *Potova*, was born. 1069

Hkhon founded the grand monastery of *Sa-skya*, and *Rñog legs śes* founded the monastery of *Gsañ-phu*. *Rma-Chhos śes* met *Pha-dampa*. 1072

Sgro-phug-pa, the pupil of *Ssur-chhuñ* and disciple of *Dkah-bshi*, was born. *Hbrog-mi Locháva* died. *Ser-grags*, the *Rñiñ-ma Lama* of *Ssur-chhuñ*, died. 1073

Sprul-sku Gshon-hod of *Bya-yul*, the disciple of *Spyan-sña*, was born. *Ses-rab Brtson* of *Khu* was born. *Brtson gyun Khu-chhen* died. 1074

The great religious institution of king *Mñah bdag rtse sde* was founded. *Rdog Locháva* visited *Kaśmír*. 1075

Gtsañ-pa Rin-po chhe, the disciple of *Bya-yul-pa*, was born. *Nam kha rdorje* was born. *Pá-tshab sgompa*, the disciple of *Kun dgah* of the *Shi byed* school was born. *Milaraspa* proceeded to study under *Marpa Locháva*. 1076

Hbrom-ston of *Rgyal* was born. *Sgro-chhos brtson*, the pupil of *Sgom* of the *Shi-byed-pa* school, was born.

After the death of *Ames*, *Mdsod dgon-pa* became the abbot of *Rva-sgreñ*. 1077

Blo-gros grags Lha-rje sgampopa of *Dwag-po* was born. 1078

Rgya-hdul hdsin practised the ascetic vows of *vinaya* at the monastery of *Dgah-va-gdon*. 1079

The foundation of the monastery of *Gra-thañ* was laid by *Gra-pa mñon śes chan* (a certain monk who was possessed of foreknowledge). 1080

Potova Rinchen gsal died, after discharging the functions of abbot at the religious seat of *Rwa-sgreñ* for one year or (according to some) three years. *Mdsod dgon-pa* died. 1081

Henceforth for many years there prevailed a religious anarchy at *Rv-sgreñ*. 1082

Byañ chhub *dge-mdses*, the pupil of *Sne-hu ssur-pa*, was born. *Ras chhuñ rdor grags*, the pupil of *Milaras-pa*, was born at *Guñ thañ*. *Milaras-pa* performed asceticism to attain sainthood. A. D. 1083

Sami sgom-pa Smon lam hbar, the pupil of *So-chhuñ-pa*, was born. 1084

CYCLE—II.

Sarava attended on *Potova* as his pupil. 1086

Ma Locháva Ohhos-hbar died of poison. 1088

Dgyer Sgom chhenpo Gshon-grags, the pupil of *Bya-Yul*, was born. *Rñog-mdo-sde*, the spiritual son of *Rñog Chhos-rdor*, was born. *Tshul-kphags-dan lapa*, the Buddhist scholar, was born. *Rog ses-rab blama*, the spiritual successor of *Rgyal-wa rten-nas*, was born. *Gra-pa mñon ses-rab chan* died. 1089

Brtsen hgrus hbar, known as *Bya-hdul-wa hdsin-pa* (the Vinayic priest of *Bya*), was born. 1090

Sa-chhen Kun sñiñ, the son of *Sa-skya Dkon rgyal*, recognised as the 9th spiritual emanation of *Chanrassig*, was born. The saint *Pha-dampa* visited Tibet. *Rñog Lo-cháva* returned to Tibet. 1091

The *Glañ-thañ* monastery was founded by *Glañ-ri-thañ-pa*. *Milaraspa*, after the completion of his ascetical propitiations (attainment of sainthood), proceeded towards *Tesi &c.* 1092

Niñ phug-pa Chhos grags, the saint of *Shañ* who was the pupil of *Byañ-sems Ssla rgyan*, was born.

The *Rñiñ Lama*, called *Rgya-nag-pa* (the Chinese), was born. *Ras-chhuñ-pa* met *Milaras-pa*. 1093

The monastery of *Lodgon* was founded. 1094

Tshul-khrims dpal, the red cap Lama, was born. 1095

Bkra sis rdorje of *Shañ Ston*, a *Rñiñ-ma Lama*, was born. *Marpa Ohhos blo* was born. 1096

Hod sser señ-ge, the disciple of *Bya-yul-pa*, was born. *Dva gs-po Chhos gyuñ*, the chief spiritual son of *Sgampo*, was born. 1099

Ye-rdor of *Hohhad kha*, the disciple of *Sarava*, was born. *Pha-dampa* visited China. 1100

On the demise of *Hkhon-ston Dkon-mChhog rgyal-po*, *Bari Locháva* ascended the throne of *Sa-skya*.

On the death of *Glan-tshul byañ*, *Hbrin ston* succeeded to the headship of *RGyal* (became abbot of *Rgyal*).

Rñog Chhos rdor died. 1101

Stab ka-wa Darma grags, the disciple of *Sarava*, was born.

- Khyuñ tshañ Thod-dmar-va was born. • Stod luñ-pa founded the monastery of Btson-gro dGonpa. Spyān sha tshul hbar died at Sñug-rūm. Sgrol Sgom, the pupil of Sgampo, was born. 1102
- Sgam-po-va received the final vows of monkhood. 1103
- Potova rinchen gsal died. 1104
- Gtūm-ston Blo gros grags, the pupil of Sarava, was born. Phu-Chhññ-va died at the monastery of Poto dgon. 1105
- Steñ-pa Lo cháva who brought the Káśmírīan Pandit Alañka Deva was born. 1106
- Chhos-señ of Phya-pa was born. After the death of Rnog Locháva Shañ-Tshe sññ Chhos kyi blama held the headship of Gsañ-phu for thirty-two years. • A succession of twelve lamas occupied a period of 159 years. Sñug-rum-pa chhenpo died. 1108
- Rdorje rgyal-po (Phagmo-grub-pa) was born. Karma dugsum mkhyanpa was born. Sgampo served Milaras-pa as his pupil. 1109
- Kun-sññ ascended the throne of Sa-skyā. • The Gva-gor-dgon-pa was founded by Gñal Chhos hbar. 1110
- At Chhu-bar Milaras-pa triumphed over a troop of demons. Sgampo performed ascetic propitiations at Hol kha. Gñal Chhos hbar died. 1111
- The final visit of Pha-dampa to Tibet. The incarnations of Las chhen Kun-rgyal, &c., founded monasteries in Bya-yul. 1112
- Khyuñ tshañ yeśes blama, the disciple of Ras chhuñ, was born. Jo-tshul Ses, the spiritual son of Rñog mdo-sde, was born. Kham luñpa Chhenpo, the pupil of Hgrom, died. 1114
- Sgompa-tshul Khrims of Dvag-po was born. Rgyal-va ye-grags dmar-va was born. Stod Luñpa Chhenpo died. Se-ston Kun rags died. 1116
- HChhus dar brtson, the disciple of Sgro (of the Shi byed school), was born. Some of the Gter-ston of the Sññ ma sect discovered hidden books. Pha dampa died. 1117
- Ma Khro-phu Rgyal-tsha, the disciple of Pañchen Sákya sññ, Rñog-mdo-sde and Phag-gru, &c., was born. • Yeśes hbar of Snehu Ssur died. 1118
- Dgyer sgom founded the monastery of Rgya-ma Rin-chhen sgañ-rññ. 1119
- Hbrññ-ston died. Skam ye-rgyan of the Shi-byed school died. 1119
- Thog-med grags, the spiritual son of Rñog mdo-sde, was born. Rma Rna-ra-va became the abbot of Rgyal. The age of Samádhi commenced. 1120

Chhos rgyan of *Se-skyilbu*, the disciple of *Hohbad ká*, was born.

The monastery of *Sgampo dgonpa* was founded by *Dvags po Lha-rJe*.

1120

Thogs med Hod of *Rñog* was born. *Brtson-grags* of *Shañ* was born. When *Skor-chhañ* died, his body received animation. The resurrection was due to the Indian saint *Nirupa* having entered it in a miraculous manner.

1121

Sla-hod, the spiritual son of *Hkhon-phu-pa*, was born. *Gyubtag pa* was born. *Gshon-brtson* of *Glañ-luñ*, the pupil of *Bya-yul Locháva*, was born. *Rje Milaras chhen* died.

Rde-rje señge of *Glañ thañ* died.

1122

Jo Hbum, the father of *Rta-ston Jo-ye* and *Jo-bsoñ* of the *Rhiñ-ma* school, was born. The later *Kun-dgañ* of the *Shi-byed* school died.

1123

Karma dus mkhyen was admitted into the order of monkhood by *Tre-po mchhog blama*. *Achârya Abhayakara* died.

1142

Mal Kapa chan, the disciple of *Sama*, was born. *Lche-ston yon-tan gssuñ* of *Se-brag* was born.

1125

The *Kaśmîrian Paudit Sâkyâ Srî* was born.

Hjig-rten Grags-pa Rgya-va rten, who became the disciple of *Pâ-tshab sgom-pa* of the *Shi-byed* school, was born. *Hod hjo gshon-nu yontan* was born.

The 13th *Rigs-ldan* (*Kulika*), called *Sna-tshogs gssugs* (*Viśva-rûpa*), ascended the throne of *Sambhala*.

1126

Dge-bśes glan of *Rgyal* was born. *Padma-rdorje Ras-pa* (he with locks) of the *Hbrug-pa* school, was born.

Karma dus mkhyen visited *Dvus*. *So-chhuñ dge hbar* died.

1127

Sbal-te Dgrañ bohóm-pa, the saint of *Balti*, was born. *Jo hod gochuñ*, also called *Rñog jo va-soñ*, was born. *Rma Narava* died.

1128

Ses rab Byañ-chhub, also called *Dvags po Sgom-Chhuñ*, of *Dvags-po* was born.

Rgyal tsha Byañ yeses became abbot of *Rgyal gdansa*. *Snubrchhos hbar* died.

1129

Karmapa Ses-rab hod of *Shañ* died. *Rgya-hdul hdsin-pa* died. *Sa-vo-sgañ-pa* died. *Ses rab rgyam* of *Dol* died.

1130

The red cap *Bama Tshul khrims hbar* died.

1131

Nam-mkhah hod of the red cap school, who was the re-embodiment of *Shva rmar Tshul dpal*, was born.

Dus mkhyen received the final vows of monkhood from *Mal hdul hdsin*.

1132

- *Sgampo hdul hdsin* was born. *Sgrb-phugpa* died. 1133
Mñah bdag Nñaral, king of Tibet, (recognised as the 11th
incarnation of Chanrassig), was born. 1134
Hod sser Señge founded the monastery of *Khrom Kam*
dgonpa at *Khrom Gsher*. 1136
• *Sañs rgyas dpon-pa*, the younger brother of *Rgyama dgyer*
sgom, was born. *Shon-hbyuñ* was born. *Rog bkra grags*, the
spiritual son of *Rog Ses-rab blama*, was born. *Gshon-hod* of
Bya-yul died. 1137
Due Mkhyen visited *Sgampo* at *Dvagpo*. *Khyuñ-po* died.
Rgyal-tshab Byañ yeśes died. 1138
Hbrdm ston of *Rgyal* became abbot of *Rgyal gdansa*. 1139
Sarava yontan grags died. 1140
Bsod nams rtse-mo, the spiritual son of *Sa-skya Kun-sñiñ*,
was born.
Bkraśis dpal of *Thañ-pa chhenpo* in *Stag-luñ* was born. 1141
H jig-rten gsum mgon Rin bssañ the governor of *Hbri-goñ*,
was born. After the death of *Hbrom-ston* of *Rgyal*, the abbot-
ship of *Gdansa* remained vacant for nine years. *Ar* spent his
summer recess at *Gdansa*. *Khu-śer brtson* died. 1142
Dgyer sgom tshul señ, the disciple of •*Mal Ka-va chan* and
Phag-gru, was born.
Gsañ ston spyipa chaspa, one of the *Pan chhen* of *Sa-skya*,
was born. 1143
Hkhonphu-pa, the brother of *Ma chig Sama*, died. 1144
Rñog jo bsod died.
Rgyal Chharmo, the spiritual son of *Rñog thog med*, was
born. *Rñogjo Hod* died. 1145

CYCLE III.

- Rje-btsun Grags-pa rgyal-mtshan*, the spiritual son of *Sa-*
chhen, was born. 1146
Kun-ldan Ras Chhuñ, the younger brother of *Khro-phu*
rgyal-tsha, was born.
Rñiñ-ma Rgya-nag-pa, the disciple of *Sgro-phug Rñiñ-ma*
Lama, died. 1147
Shig-pa bdud rtsi, the disciple of *Rñiñ ma Se-brag*, was
born. *Machig Sama* died. 1148
Rog Ses-rab blama, the religious and ministerial successor
of *Rgyal-va-rtten-na*, was born.
Dvagpo sgom-tshul held the abbotship of *Sgampo*. *Dpal-*
chhen Hodpo chhe, the son of *Sa-chhen*, was born. 1149

- Phagmo grub-pa interviewed *Rje-Sgampo-va*. 1150
- Rdor-señ*, the younger brother of *Rñog Chhar-mo*, was born. *Sgro chhos brtson* died. 1151
- Chhag Locháva*, also called *Dgra-bchom Rtehu rava*, the disciple of *Steñ-pa Locháva*, was born.
- Gro-bdud-rtsi grags* of *Snarthañ* was born. *Gtun-ston* founded the monastery of *sNar thañ*. *Dag-pa ses tsul Pha-gs-paof Nan lam* became abbot of *Rgyal gdansa*.
- Dvags-po Sgampo-va* died. 1152
- Rdorje tshul khirms* of *Hbri goñ* was born. *Dvags-po Sgom-*, *tshul* founded the monastery of *Mtshur-lha luñ* at *Stod-luñ*. 1153
- Duñ mkhan pa* founded the *Karmapa* monastery of *Gsra mtshur Lha luñ* at *Gshuñi gru bshi Lha luñ*. 1154
- Thogs med grags* of *Rñog* died. 1155
- Kun dgañ rdorje*, the spiritual son of *Rñog jo-tshul*, was born. 1156
- Dvañ-phyug byañ rin* of *Lha luñ*, who was the disciple of *Se-spyil-pa*, was born. *Bssañ mo*, the spiritual son of *Sañs rgyas dpon ston*, was born.
- Niñ kbum*, the son of *Rñiñ-ma shañ-ston*, was born. *Pá-tshab sgompa* died. *Sa-chheñ Kun-sñiñ* died. *Rñog jo-tshul* died. *Phag gru-pa* founded the monastery of *Gdansa mthil*. 1157
- Bsod nams rtse mo* became the grand hierarch of *Sa-skya*. *Dge-bśes Nanlampa* died. *Dus mkyen* founded the monastery of *Mtshur-phu*. 1158
- Sans-rgyas sgompa rdor gshon* of *Bya-yul* was born. *Dge-bśes lchañ rib* was born.
- Rma Locháva* and *Yañ dnenpa*, the immanations of *Machig Sama*, were born. 1159
- Yeśes rdorje* (also called *gtsañ-pa Rgya ras pa*), the disciple of *Hbrug-pa gliñ raspa*, was born. *Gtsañ rinpoche Nam rdorje* died. *Ras-chhuñpa* died. 1160
- Chhiñgis Khán*, the conqueror, who turned the wheel of might, was born.
- Skor Nirúpa tava* died. 1161
- Rta ston jo yeśes*, the *Rñiñ ma Lama*, was born. 1162
- Gños Rgyal-va lha nañva Sañs rin*, the disciple of *Skyob-pa*, was born.
- Dus mkhyen* founded the monastery of lower *Kam-po gnas nañ*. The monastery of *Hchhad-ka gsarma* was founded by *Se-skyil-pa*. *Khyuñ-tshañ Thod dmar* became abbot of *Rgyal-gdansa*. *Hab jo Sras*, the disciple of *Yumo*, died. 1163

* Bya-hchhañ-kha-pa founded the monastery of Malgro Bya-hchhañ kha. The two Gliñras-pa of Stagluñ interviewed Phag-gru.

Ser-hod, the son of Rog bkra-grags, was born. 1164

Gtun-ston died at Chhos-luñ. Rdor-ston. Ser grags became abbot of SNarthañ.

Rñog mdo-sde died. Ser hod, the spiritual son of Rog-bkra Grags, was born. 1165

Mñahri dge-mdsas died. Shañ ston bkra rdor, the Rñiñ-ma lama, died. The abbot of Hbri-goñ became the disciple of Phag-gru. 1166

Jo-bsod of Dvus, who was the younger brother of Rta-ston-jo-ye (Rñiñ-ma Lama), was born.

Hdsed Dharmabodhi died. 1167

Gyam bssañ Chhos smon lam, the disciple of Ssva-ra-va Skal-ye, the son of Phag-gru, was born.

The Kashmirian Pandit Sakya Srí took the final vows of monkhood. The monastery of Hdod spañ phug was founded by Dus-mkhyen. The monastery of Skyor luñ was founded by Spal-te. Dvagspo sgom-tshul died, after which the abbotship remained vacant for two years. Phyá-pa Chhos señ died. 1168

Bsod rdor of Sbom-brag, the disciple of Karma sañs rgyas Ras-chhen, was born.

Rgyal died at Phag-gru, and the abbotship of Sdan-sa remained vacant for six years.

Khrom gser died at Kam kam. 1169

Rin-chhen Sesarab, the younger brother of Rog Serab hod, was born.

Sami smon lam hbar died. 1170

Gragsrgyan-pa ascended the throne of the Sa-skya hierarchy. Ser byañ was appointed to the abbotship left vacant by Sgampo. 1171

Khro-phu Lo-cháva Tshul-ses byams dpal, who was a nephew of the Khro-phu Rgyal tsha brothers, was born. Rog Sesarab lama died. 1172

Darma grags pa of Stabs-ka died. Jo-hbum, the Rñiñma lama, died. 1173

Rinchhen Hod, the disciple of Phag-gru, was born. The monastery of Tshal was founded. Bya-hchhad kapa died. 1174

Chhos rje Sgañ-pa was born. Khyuñ tshañ yes'es Lama died. 1175

DPon'ras dar señ of the middle Hbrug school was born. The Skyob-pa (hierarchy) of Hbri-goñ received the final vows of

monkhood. *Šhañ Lo-cháva grñb-dpal* died. *Dvags-po Chhos gyuñ* died. 1176

Sans rgyas,sgompa of *Snarthañ* was born. *Ye-grags dmar* became the abbot of *Rgyal-gdan sa*. 1178

Gshon rdor of *Mgar dampá Chhos sdiñ*, the disciple of *Skyob-pa*, was born. *Hbom dgon Serab dpal*, the disciple of *Stag luñ-pa*, was born. The monastery of *Stag luñ dgon* was founded by Lama *Stag luñ-thañ-pa*. 1179

Sa-skyá Panchhen, the son of *Dpal-hod sros*, was born. *Bsod rgyan* of *Ko-brag* was born.

The monastery of *Rgyama Rin sgañ* was rebuilt by *Sans rgyas dven-ston*. 1180

Bsod namś rtshe of *Sa-skyá* died. *Lha-btsun ssia Hod* of *Hkhon-phu* died.

Rñog Chharmo died. 1181

Ssañs tsha bsod rgyan, the younger brother of *Sa-skyá* Panchhen *Kun dgah rgyal-mtshan*, was born. 1183

The monastery of *Karma lha sdeñ* was founded by *Dus mkhyen-pa*.

Rdo ston ser grags died at *Snarthañ* and was succeeded by *Šhañ btsun rdor hod* who was born in the year *iron-horse*. 1184

The venerable *Hgro-vahi mgonpo dvañ phyug Hod Lha-luñ dpon sras* was born.

Grags rgyal, of *Kharagpa*, who was the spiritual son of *Rgod-tshañ* the *Hbrug-pa* Lama and disciple of *Bhuriba*, was born. *Ñiñ phug-pa* died. *Rog Bkra śis grags* died. 1185

Dvon Ser hbyuñ, the disciple of *Skyob-pa*, was born. *Bloras dvañ brtson* of lower *Hbrug*, who was the disciple of *Glsañ rgyara*, was born. The monastery of *Tshal guñ thañ* was founded by Lama *Šhañ brtson grags*. The image *Lhachhen* was constructed. *Rgyal-va yeśes* died at *Grags dmar*. 1186

Hbrug-pa gliñ ras pa Padma-dorje was born. 1187

Bsam gliñ-pa, the disciple of *Gañ-ba* and spiritual son of *Karma dus mkhyen*, was born.

Rgos tshañ mgon-po rdorje of upper *Hbrug*, who became the disciple of *Rgya ras*, was born.

Dge-bśos Glan rgyal became the head of *Gdan-sa* (chief seat of the hierarchy).

The monastery of *Mtshur-phu* was founded by *Dus mkhyen-pa*.

Hor Chhiñ-gis became king of the Mongols. *Se-spyil len-pa* died, 1188

* The king of upper Mo-rtse Rgyat-po presented the Lord Buddha's image with a golden crown.

Hchhad-ka monastery was governed by Lhaluñ dvañ phyug of Se-spyil.

King Chhiñgis conquered Man-churia. Steñ-ba Lo-cháva (Tshul-khrim hhyuñ gnas) died. 1189

Saím rinpoche of Bya-yul (Sans-rgyas Ston-pa grags) was born. Rin mgon sku yal-va of Stag luñ dvon kar was born.

Glan died and was succeeded by Dge-bśes dri-hdul at Rgyal Gdansa. 1190

King Chhiñgis conquered Solon country. Mchhus dar brtson died. 1191

Skysa-ston byañ rin poche held the abbotship of Rgyab-gdansa. Lama shañ died at Guñ thañ. Karma Dus gsum mkhyen-pa died. Gshon-un brtson hgrus of Glañ-luñ died. Dvus-pa died. 1192

Henceforth Chhiñgis became emperor of China. Snas-thañ Shañ btsun-died and was succeeded by Groms chhe-be who was born in the year *water-bird*. 1193

Bya-skyuñ-pa (mdo-sde mgon of Phorog), who was kobrag-pa's disciple, was born. Khro-Lo-cháva visited Nepal. Chhiñgis conquered Tartary. Khro-phu rgyal-tsha died. Yon-tan gssañs (Rñiñma Lama) died. 1194

Jo hbar, the son of Nima-kbum (Rñiñ-ma Lama), was born. Chhiñgis subdued the Danmag. 1195

The latter Chhos rje dpal Chhag was born. 1196

Skyob-pa and Stag liñ-ba built temples at Phag-gru. Khro Lo-cháva invited Mitrpa to Tibet who after a staying there for 18 months returned to India. Chhiñgis conquered Kherañ. Jobsod (Rñiñ-ma Lama) died. 1197

Dvags-po grol-sgom died. Shva-dmar nam hod died. Rñiñ-ma-pa Shig-po died. 1198

Sgam-po sñi sgam-chhen-po was born. Bkra-Grags, the re-embodiment of the red-cap Lama called Nam-hod who was a disciple of Dus mkhyen, was born. Gshon-señ of the middle Hbrug-pa school was born. Khro-Lo-cháva brought Buddha Sri to Tibet. Chhiñgis subjugated Nahimanpa Ta-ge. 1199

Dge-bśes lchañ-ri held the abbotship of Rgyal gdan-sa. Sans rgyas sgom-pa protected the Lo-cháva of Bya yul. Gssi brjid Grags, the spiritual son of Rñog kun rdor was born. 1200

Spyan sña Rinchen Ldan, the disciple of Ko-brag-pa and Yuñ dgonpa, was born. Chhiñgis conquered the whole of Hor. 1201

Rgva Lo-cháva (*Rnam rgyal Rdorje*) of Roñ was born. Phag-gru Thog-rdug pa was born. Sans *rgyas yar* byon Ses rab blama of Stag luñ was born.

Sans *rgyas ras* pa Rinchhen smonlam, the disciple of Shí-byed pa Rog shig-po, was born.

Sa-skya *dpal*-chhen *Hod* died.

1202

Karma Bakshi Chhos *hdsin*, the disciple of *Sbom-brag*-pa and pupil of Karma Ras chhen, was born. Khro Lo-cháva brought the Kashmirian Pandit Sakya *Srí* to Tibet.

Chhiñ-gís subjugated Harilig. Dgyer-tshul Señ died.

1203

Rgyal-po dgah, the younger brother of *Rñog Gssi-brjid*, was born. The monastery of *Bde-va-chan* at *Sñe-thañ* was founded by *Rgya-hchhiñ rupa*, the disciple of *Gñal shañ*.

His nephews, Sans *rgyas dpal* and others, managed the monastery after his death.

1204

The monastery of *Gyam bssañ dgon*-pa was founded by Chhos Smon lam of *Gyam bssañ*.

1205

Chhiñgis visited Tibet and subjugated all its provinces with the exception of *Mi-ñag*.

•CYCLE IV.

Ssvara-yeseñ, the pupil of Phag-gru, died.

1206

Spyan-sna grags hbyuñ became the abbot of Phag-gru *Gdansa* which dignity he held for twenty-seven years. Sakya Pañḍita received the final vows of monkhood from Sakya *Srí* Pañḍita.

1207

Dvon dkarva occupied the abbotship vacated in consequence of the death of Stag luñ thañ-pa. *Rgya-ma Sans rgyas dvon ston* died.

1209

Tilla rdor grags, the younger brother of *Hbri-goñ*-pa, was born.

Dvon-po Dar señ became abbot of *Hbrug Raluñ* after the death of *Gtsañ-pa rgya-ras*. *Mal-ka-pa-chan* died.

1210

Hguru Chhos *dvañ*, a *Rñiñ-ma gter-ston* was born. Khro-Locháva constructed a gigantic image of Maitreya, eighty cubits high, which he also consecrated.

1211

Rgyalva, the eldest spiritual son of *Hbrug-pa Rgod-tshañ*-pa, *Yañ dgon*-pa and *Rgyal-mtshan dpal* were born.

The Kashmirian Pañḍita Sakya *Srí* returned to Kashmír. The monastery of *Glañthañ Chhqs-sde* was founded.

1212

Gshon-nu yon-tan of *Hod jo-va* died. *Rñiñma Nima hbum* died.

• The pupil of *Hjam-gser* called *Chhós Sku-hod sser*, who became the disciple of *Semo-chhe* the professor of *Dus hkhor*, was born. 1213

Khublai (emperor *Se-chhen*) *Khán* of *Hor* was born.

SPal-te Dgra-bchom died. 1214

• *Shva-dmar-tshul dpal*, the disciple of *Karma Bakshí*, was born. *Sñe-mdo thams chad mkhyen-pa*, the eldest son of *Smar-señge*, was born. *Chhag dgra-bchom* died.

Grags rgyan of *Sa-sky* died. 1215

Rdorje tshul-khrims became the heirarch of *Hbri-goñ*. *Skyob-pa Hjig-rten ngon-po* died.

Khrö-phu kun-lñan-ras-pa died. *Yañ-dven-pa* died. *Rgyal-va Rten nas-pa* died. 1216

Rin-ohhen rdorje his younger brother, who was the 12th (in succession), was born.

Dge-bśes lchañ riba died. *Sgampo hñul hñsin-pa* died. 1217

Glañ ston śesrab Señ became abbot of *Rgyal-gñan sa*.

Rñog rdorseñ died. 1218

Rdorje tshul Khrims of *Hbri-goñ* died. 1220

Dvon Śesrab byuñ became hierarch of *Hbri-goñ*. *Bud-dhism* was first introduced in *Hor* (*Mongolia*). *Chhiñ-gis* annexed *Sar-tha-gva-chhen*. 1221

Rdorje yeśes (*Chhos go-ba* of *Hbri-gññ*) was born. *Hkhrul Shig Darma señge*, the disciple of *Rog-mchhad gsun*, was born. 1222

Dvon dkar commenced building the grand hall of worship at *Stag luñ*.

Gños Lha nañ-va died. 1223

Bde-legs rgyal-mtshan of *Nerañ*, who became the pupil of *Orgyan Rinchhen dpal*, was born. *Shañ ston htshem-pa* became abbot of *Rgyal-va gdansa*.

The monastery of *Dge-hñun sgañ* was founded by the two disciples of *Sākya Śrī Pañdita* named *Byañ* and *Rdor*. They also founded the monastery of *Sñemo tshag-mig*.

Sākya señge founded the monastery of *Namriñ* in *Byañ* (north) after which he died. *Sākya Śrī* died in *Kashmír*. 1224

Rin Señ of *Thog-kha* of *Hbrigoñ* was born. The fourteenth *Kulika* ascended the throne of *Sambhala*. *Chhiñ-gis* subjugated *Miñag* in *Tibet*, after which he died. 1225

Ogoti, the son of *Chhiñgis*, who was born in the year *fire-sheep*, assumed the sceptre of the *Mongol-China* kingdom. 1226

Sgampo Sñepa jo sras was born. *Sans rgyas sgom-pa* died. 1227

Orgyan Señge rinchen dpal, the pupil of Rgod tshañ-pa of Stod Hbrug, was born.

Rta-ston jo-ye, the Rñiñ-ma Lama, died. 1228

Bkrasís blama of Stag luñ was born. Jo-kbed, the Rñiñma Lama, died. 1229

Rin-señ of Kham luñ in Bya-yul was born. Sans rgya jo-vo dvañ phyug gshon-nu of Bya-yul was born. Gromo-ohhe of SNar thañ died. Lha-luñ dvañ phyug died. 1230

Chhos smon lam of Gyam-bssañ died. Rog Sesrab blama was born.

Ogoti died. Guru Chhos dvañ recovered concealed religious books from the rock of Gnam-skas brag. 1231

Sañs ston tshul mgon of the Sans-pa school was born. Ser-hbyuñ died at Hbrigoñ. Gotan, who was born in the fire-tiger year, ascended the throne of Hor. Rñog kun-rdor and Rtogs ldan bssañ died. 1232

Phags-pa, the son of Sa-skya Ssans-tsha, was born. Señge-sgra, the son of Rñog rgyal-dgañ, was born. 1233

Dvon dkar skuyalma of Stag luñ died. Ngam-po Sñi sgom-chhen died. 1234

Dar Señ, the disciple of Rgya ras of Gtsañ, died at Hbrug ra luñ. Gshon-sañ succeeded him. 1235

Rin-rgyan and Ye-hbyuñ, the sons of Ssañs tsha of Sa-skya, were born. 1236

Phyagna rdorje, the younger brother of Hphags-pa of Sa-skya, was born.

Ssañs tsha Bsod rgyan of Saskya died. 1237

Grags-pa yeśe's of Phag-gru was born. Grags bsod (Htsham behad-pa) of Hbri guñ was born. The Mongol chief Chhigya dorta, with his troops overrun Dvu (U) and Gtsañ, and killed So-ston and five hundred monks of Sa-skya, after which he burnt Rva-sgreñ and Rgyal-khañ monasteries. 1238

Chhos kyi blama died at Snarthañ. Dvon-Ser-hbyuñ died. 1239

Rin bssañ, the younger brother of Rñog Señ ge sgra, was born. Meloñ Rdorje, the pupil of Rñiñma jo kbad and disciple of Señ-ge rgyab-pa, was born. Jonañ kun-spañ Thuga brtson-hgrus rje, the pupil of Chhos sku hod sser, was born. 1241

Hphags-pa and Phyagna, the two nephews of Sa-skya Pañdita, proceeded to Mongolia. Rog-ser hod died. Hbom dgon-pa of Stag luñ died. 1242

Rog-shigpo Rin-chen Sesrab died. 1243

Chhos kyī rdorje, the younger brother of Rñog Rin-chhen bssañ-po, was born.

Sa-skyā Paṇḍita arrived at Lan-ju (Lan-chau). 1244

Sa-skyā Paṇḍita interviewed the Mongol king Gotan. 1245
Sñe-mdo smar señ died.

Sa-skyā Paṇḍita's saintly powers were tested. Having found him to be a sage and saint, the king imbibed faith in him. 1246

King Gotan sent a proclamation to Tibet making a present of the provinces of U and Tsañ to the Sa-skyā hierarch. Gya-pa gañs-pa, the disciple of Dūs-mkhyen, died. Sbom-grags-pa died. 1247

Grags rin gñis mchhod-pa of Phag-gru was born. Se-Spyil Kha-va yeśes of Lhobrag was born.

Shañ dkon dpal was born. Lo-cháva Ras died at the capital of the Hbrug-pa hierarchy. Sans-Sgom of Sñas thañ died. 1248

Sans rgyas dvon grags dpal of Stag luñ was born. Ses-rab Señ-ge of Roñ, the spiritual son of Rgva Lo-cháva, was born. Nima señge of middle Hbrug was born. 1249

MChhim nam grags became abbot of Snarthañ. Sa-skyā Paṇḍita died at Sprul-sde in Mongolia. King Gotan died. 1249

Muñ-khe, who was born in the year *fire-hare*, ascended the throne of Mongol-China. The Mongolian army suppressed Mon mkhar mgonpo gdoñ in Tibet. 1250

HPhags-pa of Sa-skyā became prince Khublai's spiritual guide. The Saskya-pa hierarch took possession of the thirteen provinces of Tibet, called Khri-skor bchu-gsum. 1251

The Mongolian king went at the head of an army to Gara ljañ yul and returned to his capital in the following year. 1252

Grags señ of Mun-mebrag kha-wa, the pupil of Jonañ kun ssañ, was born. 1253

Spyan sna grags hbyuñ died. 1254

Bakshi became the spiritual guide of the Mongol king Muñ-khe. Ssem grags señ of Bya-yul died. Guru Chhos dvañ unearthed the six Rñiñ ma scriptures. 1255

Sans-rgyas dpal bssañ (Stag luñ dvon-po) was born. Phorog mdo-sde died. 1256

Señge rinchen of Spañi-skyā and of the middle Hbrug-pa school was born.

Kun dgah bssañ-po of Sñe-mdo, an incarnation of Rgod-tshañs-pa, was born.

Rgyal-va yañ dgonpa, the son of Thams chas mkhyenpa, died. Rgod tshañ mgon rdor of Stod Hbrug died. 1257

Bde-legs rgyal mtshan founded the monastery of *Ssañ ssañ nerañ*. *Lha hgro mgon dvañ phyug* died.

Muñ-khe, the Mongol king, died.

1258

Yon rgyam, the pupil of *Jonañ kun spañ*, was born. *Karma Bsam-gliñ Rinchen* died.

1259,

Rgyal mtshan hbum of *Hjag*, who became a leader of the *Sañspa* school, was born.

Karma Bakshí, during the years *fire-serpent*, *iron-monkey* and *iron-bird*, made miraculous religious demonstrations. *Bsod rgyan* of *Go-brag* died.

1260

Bdag-chhen bssañpo dpal, the son of *Sa-skya Ye-hbyuñ*, was born.

Sakya bssañpo, well-known by his other name *Stag luñ Lo-cháva*, was born.

1261

Ssur-phu-va, the pupil of *Spyan-sna rin ldan*, was born.

The great shrine of *Mtshur-phu* was built by *Bakshí Ñe ldan sgom*.

1262

Sans rgyas ston tshul Khirims Señge of *Bya-yul* was born.

1263

Chhag chhos rje dpal died.

H Phags-pa of *Sa-skya* returned to Tibet from Mongolia.

1264

Kumára, the son of *Meldñ rdorje* (of the *Rññma* school), was born.

Gshon-señ died at *Hbrug-Raluñ*.

1265

CYCLE V.

Thog rdug-pa died at *Phag-gru*. *Phyagna* of *Sa-skya* died.

1266

Dharmapála Rakshita, son of *Phyagna* of *Sa-skya*, was born.

1267

Hphags-pa again returned to *Hor* (Mongolia).

1268

Emperor *Sa-chhen* (*Khublai*), the grand son of *Chhiñ-gis* was engaged in building *Peking* and three other cities, from the year *wood-mouse* up to this year.

Kharag grags rgyal of *Hbrug* died.

1269

Gshon-nu Smon lam of *Bya-yul* and *Spyi-ther pañi Dvonpor Grags-pa* of *Dvagpo* were born.

1270

Sans rgyas yar-byon of *Stag luñ* died.

1271

Guru chhos dvañ died.

1272

The monastery of *Tharpagliñ* was founded in the confines of *Nepal* and *Tibet*.

Ye-hbyuñ of *Sa-skya* died in *Ljañ-yul*.

1273

Sakya bssañ-po of Sa-skya became the viceroy of the thirteen provinces of Tibet, called Khri-sker bchu gsum. 1274

Hjam-dvyañs don-rgyan of Sa-skya and Dvañ-bo brtan Blama of Bsos rgyan were born.

Sans rgyas dvon grags dpal of Stag-luñ founded the monastery of Byams rinpo-chhe. 1275

Ssur-khañ-pa dvañ ye of Se-spyil was born. Grags-pa bsod dpal of the Bkrah-brgyud school was born. Sñe-mdo Thams chad mkhyen-pa died. 1276

Rdorje rinchen of Hbrigon was born. 1277

Yeses blama of Stag luñ was born. Sgampo chhos brgyan was born.

Rinchhen rgyal mtshan of Sa-skya died. Bchuñ Tilli died at Hbrigoñ. 1278

Rinchhen Chhos rgyal of the Shi-byed school, who was the grandson of Uphrul shig-dar señ, was born. Hphags-pa of Sa-skya died. The twelfth Gchuñ died.

Sansrgyas Ras-pa of the Shi-byed school died. 1279

Dharmapāla became hierarch of Sa-skya. Bya-roq Rdsoñ (jong) was captured. Rñog Gssi-brjid Grags died. 1280

Bya-yul Khams lun-pa died. Rga-Lo-cháva of Miñagag died. Bkra-grags, the red-cap Lama, died. 1281

Chhos rgyan, the son of latter Rñag Chhos rdor, was born. Shva dmar Gragr señ, the first incarnation of Bkra-grags the red-cap Lama, was born.

Rdor rgyan of Roñ, the first disciple of Ser señ, was born.

Karma Bakshí died. 1282

Sans rgyas Sgompa of Bya-yul and Tshul khims Sesrab were born.

The third Karma-pa hierarch Rañ byuñ rdorje, an incarnation of Karma Bakshí, was born.

Rdor-rgyal, the 28th hierarch of Hbrigoñ, was born. Rñog rgyal po dgah died. 1283

Lha-blo hod of Se-spyil was born. The Hbrigoñ-pa authorities burnt Bya-yul.

Sañs rgyas Gchuñ Ston died, and the abbotship remained vacant for five years.

Thog kha-va died at Hbrigoñ. 1284

Lha brag kha-va died. 1285

Gyuñ-ston Rdor dpal, the pupil of Ssur-byams señge (the Bñiñ-ma Lama), who was Karma Rañ byuñ's spiritual guide, was born.

- Dharmapāla died at Sa-skyā, and Sara-va Hjam dvyāṅs succeeded him in the hierarchy. Ne-señ of Hbrug Raluñ died.
 Ratna guru of Stag luñ was born. Htsham bchadpa died at Hbrigoñ. Phag-gru Grags-ye died. 1287
- Señge rgyal-po of middle Hbrug was born. Mohhim name grags of Snarthañ died. 1288
- Bu-ston Rin-chhen grub was born. Rñiñma Lama Legs-lan was born.
- The Sa-skyā-pa authorities sacked Hbrigoñ. 1289
- Tshul-mgon of Bya-yul was born. 1290
- Gser-gliñ bkra śis dpal, a follower of Sans-pa, was born.
- Dol bu Ser-rgyan, a disciple of Jonañ yon-rgyan, was born.
- Kun-mkhyen chhos sku Hodsser died. 1291
- Grags rgyal of Phag-gru, who had acquired the fourfold Rñiñma perfections, was born.
- Urgyan mgonpo śer dpal of Stag luñ died. 1292
- Mkhan-chhen Jñāna Prajñā was born. Sa-chhen's (Khub-lai's) grandson Olchakithu, who was born in the year wood-ox, became the emperor of Mongol China. 1293
- Rgyal-sras Thogmed bssañ po dpal was born. The Rñiñma Lama Gyuñ-ston Ssla-va Hjam dvyāṅs bsam-hgrub rdor je was born. 1294
- Mchhuim karma kloñ-chhen-pa was born. Sgam-po Sñi-va Jo-sras died.
- Sans rgyas dpon-grags of Stag-luñ died. Emperor Khublai died. 1295
- Bkraśis blama died at Stag-luñ. 1296
- Karma Rñiñ Lama Gyuñ-ston visited Hor. 1297
- Tisri Kun-blo, son of Dpal bssañ of Sa-skyā, was born.
- Gyag-sde Panchhen (Brtsen-hgrus Dar rgyas), the pupil of Shva-dmar Grags-señ, was born. 1298
- Ratnākara of Stag-luñ was born. 1299
- Tiñi situ Byañ rgyan of the Phag-gru dynasty was born. 1301
- Dvañ lo-cháva Byañ-chhub rtsemo, also called Blo-brtan dpon-po, was born.
- The monastery of Lha-steñ was founded by Rañ-byuñ rdorje.
- Hkhrul shig Parseñ of the Shi-byed school died. The Rñiñ-ma Lama Meloñ rdorje died. 1302
- The venerable nun Legs blo rgyan, a disciple of Bssañ dpal of Sa-skyā, was born. 1304
- Jonañ Phyogs las rnam rgyal, a native of Mnañ ris, who was the pupil of Dol-bu śer rgyan, was born. 1305

- Emperor Olchahithu of Hor died. 1306
- Kloñ Chhenpa, the disciple of Kumára (the Rñiñ-ma Lama), was born. Another grandson of the emperor Sa-chhen, named Khulug who was born in the year *iron-serpent*, became emperor. 1307
- The Sage Sañs ston Tshul ngon died. 1308
- The saint Orgyan pa señge died.
- Tisri kun rgyan, the son of Bssañ dpal of Sa-skya, and Hjam-dvyañs don rgyan were born.
- Rgyal-mtshan Dpal bssañ of Sañs hbañ-ra, who became the disciple of Ssur-phuva, was born. Gsar-ma Grags-sés, the twelveth Phag gru hierarch, was born. Hjäg-chhen Byams dpal of the Sañspa school was born.
- Gñis-mchhod died at Phag-gru. Dpal-bssañ of Stag-luñ died. 1309
- Gshon nu rgyal-mtshan of Ri-pa, the disciple of Ssur-phuva, was born. Rñog chhos rdor phyi ma died.
- Emperor Khulug died. Blama Dampa bsod nams rgyal mtshan, the son of Bssañ dpal of Sa-skya, was born. Sañs rgyas jovo of Bya-yul died. 1310
- In Hor, Pauyanthu (born in the year *wood-bird*), the youngest brother of the emperor Khulug, ascended the throne. Yeśes Lama of Stag-luñ died in India. 1311
- Sans-rgyas Rin-chen died at Hbrug Raluñ. Jonañ Kun spañ died. The metaphysical theory of "Luñ thig" was inculcated by Tshul rdor, an incarnate Rñiñ-ma Lama. 1312
- The sage Hjam dpal yeśes was born. Hjam dvañs Kun dgañ señge of middle Hbrug was born. 1313
- After the death of Rdorje Rinchhen, Rdorje rgyal-po became abbot of Hbrigoñ and built the grand shrine of Hbrigoñ. Sesrab Señge of Roñ died. 1314
- Kun-dgañ bssañ-po of Sñe-mdo died. 1315
- Dkon-mchhog dpal of Shañ died. 1316
- The (astrological and astronomical) work, called Rtsi Kun bsodus, was composed by Rañ-byuñ-pa. 1317
- Sgampo Sañs-rggas Chhos Señ was born. The sage Gshon-nu Grub, the disciple of Sañs-rggas ston of Sañs, died. Rñog Rin-bssañ died. 1318
- Orgyan ngon-po of Stag-luñ erected a large shrine and furnished it with images and religious books. Emperor Pau-yanthu died. 1319
- Gegen khan, the son of Pau-yanthu, who was born in the year *water-hare*, ascended the throne. 1320

Blo gros Bnam dag was born in Bya-yul. Bu-ston wrote the historical work called *Chhos khyuñ rin mdsod*. Bssañ dpal of Sa-skyā died. Emperor Gegen Khan died in Hor. 1321

Ye-sun-the-mur, the great-grandson of Sa-chhen (Khublai), who was born in the year *water-serpent*, became emperor. 1323

Rdorgyan of Roñ died. Sañs-rgyas-ston of Bya-Yul died. Señ-rgyal died at Hbrug Rañuñ. 1324

Nam mkhah rgyal-mtshhn of Lho-brag, who was Tsoñkhapa's tutor, was born. 1325

Mthah-yas (Ananta), the fifteenth Kulika, ascended the throne of Sambhala. Kun-blo of Sa-skyā died. 'Yon-rgyam, the Jonañ Lama, died. 1326

Emperor Ye-sun-the-mur died. 1327

The two sons of the emperor Khulug, namely Rinchhen Hphags (born in the year *iron-mouse*) and Kaus'alí (born in the year *water-tiger*), successively became emperors, and each died after a few months' reign. Pau-yanthu's son Chi-yá-thu (born in the year *wood-dragon*) became emperor. 1328

The abbot Yeśes bsod nam rgya-mtsho was born 1329

Don-grub dpal, the son of Señge-hbum, the spiritual son of Rñog Chhos rdor, was born.

Rañ-hbyuñ Rdorje visited Hor. 1330

Ta-dven blo-rgyan and Ta-dven Chhos rgyan, the sons of Tisri Kun-rgyan of Saskya, were born. Emperor Chi-yá-thu died. Ratna Srí, the son of Kausalí, born in the year *fire-tiger*, became emperor. After one month's reign he died. 1331

Nam-mkhah dpal of Stag-luñ was born. The monastery of Gnas nañ was founded by Mtshur. Tho-gwan themur the son of Chi-yá-thu, born in the year *earth-horse*, became emperor. 1332

Rgyan hbum of Sañs jag was born. 1333

Hbri goñ Chhos rgyal, who became Tsoñkhapa's tutor, was born. Se-spyil-pa Rinehhen Señ was born. 1334

Sgampo Chhos rgyan died. 1335

Se-spyil Lha of Ssur-khañ died. 1336

Saṅs-rgyas Sgom Phyi-ma died in Bya-yul. 1337

Ratna Guru of Stag-luñ died. Karma Rañ byuñ rdorje died in Hor. 1338

The fourth Karma hierarch Rolpañi rdotje Dharma Kirti was born in Koñ-po. 1339

Bsod nam bsañ of Smyuñ-gnas was born. 1340

Bsod nam rgyal-mtshan (Kun-spañ chhenpo) was born. Se-spyil-pa Sakya bsod was born.

On the death of Nam legs-pa, *Blama Dampa* became the *Sakya* hierarch. *Gshon-smon* of *Drag-po* died. *Kumára*, the *Rñin-ma* Lama, died. *Dpal-blo-brtan* died. 1341

Mun-Me brag Kha-va, the *J'onañ* abbot, died. 1342

According to the chronology of *Rgya-Ston* the *Sútránta vyākaraṇa* was introduced. 1343

Sakya bssañ the *Lo-cháva* of *Stag-luñ* died. 1344

Blo gros *Señge* of the middle *Hbrug-Raluñ* school was born. 1345

Lho-rin-pochhe Grags you of the *Bkahrgyud* school was born. *Kun Señ* died at *Hbrug-Raluñ*. 1346

Rje-btsun rañ hdañ-pa Gshon was born. *Theg-chhen chhos rgyal kurt bkra*, the son of *Chhos rgyan* of *Sa-skya*, was born. *Tahi Situ Byañ-chhub Rgyan* became the ruler of the entire *Dvus* (or central Tibet). *Shva-dmar Grags señ* died. The *Shi-byed-pa* abbot *Rinchhen Chhos rgyal* died. 1348

Rin rgyan Dus hkor-va, the pupil of *Hj'am-dvyañs Chhos mgon Dolbus*, was born. *Gyag-phrug Sans* was born.

Mkha-spyod dvañ-po Ye-dpal, the 'second red-cap hierarch, an incarnation of *Grags-señ*, was born. *Sans rgyas rin-rgyan*, the disciple of *Hjam-dvyañs bssam grub* the *Rñin-ma* abbot, was born. *Se-spyil-pa Lha blo hoð* died. 1349

Chhos kbyuñ rin-chhen, the disciple of *Hjag-chhen Byams-dpal*, was born. The town of *Itse-thañ* (also called *Rtsis-thañ*) was founded by *Tahi Situ*. *Rdor-rgyal* died at *Hbri-goñ*. 1350

Bsod nams lhun-grub of *Se-spyil* was born. The sage *Jñāna-prajña* died. 1351

Karma Rol pahi rdorje entered monkhood. A great earthquake took place in Tibet. 1352

Sar-rin-pochhe (of the *Bkah rgyud* school) of *Khams* was born.

Byañ-pa Tahi dven, with the permission of *Ser-rgyan*, repaired the monastery of *Ñam riñ*. *Tahi Situ* brought the whole of *Gtsañ* under his power. 1353

Blogros Señ ge of *Rgyal-lha khañ* and others commenced the *Mñon-pa* (*Abhidharma*). 1354

Hjam dpal rgya-mtsho, the adept, was born. *Chhos bshi gsarma Grags byañ* of *Phag-gru*, who became *Tsoñkhapa's* spiritual guide, was born. 1355

Tsoñ-khapa was born at *Tsoñ-kha*. His disciple *Sakya bsod* was born. *Spyan sñā-va Bsod nams Grags* was born. *Grub-pa Sesrab* of *Snar-thañ* was born. *Karma Rol-pahi rdorje* received the final vows of monkhood. 1356

- Tahi* *Sri Kun-rgyan* of *Sa-skya* died. 1357
- Baodnam Grags* of *Phag-gru* was born. *Bkra-sis dpal* *br tsegs* of *Stag-luñ* was born. *Gyag-sde pan chhen* founded the monastery of *E-bam*. *Rñog chhos rgyan* died. 1358
- Blo-gros bssañ-po* of *Gtsañ*, the pupil of *Hbahri*, was born. *Byañ dpal*, the son of *Rñog don-dpal*, was born. *Chhos bshi Rñiñ ma* died at *Phag-gru*. 1359
- Ratnákara*, the abbot of *Stag-luñ*, died.
- Jonañ Lo-cháva Ser-rgyan* died. 1360
- Riñi klab-pa* was born. *Rje Tsoñkhapa* received *abhiśeka* from *Don-rin-pochhe*. 1361
- Rgod phrug ras-pa Grags khyuñ* of the *Bkah brgyud* school, a native of *Niuu*, was born. *Rje-blama* (*Tsoñkhapa*) became a (*Sramaṇera*) neophyte monk under *Don rinpa*. *Tshuñ ngon* of *Bya-yul* died. *Rñiñma Kloñ-chhen* died. 1362
- Darma Rinchhen* (*Khri-chhen rgyal-tshab*) was born. *Yeses rinchhen* of middle *Hbrug* was born. *Bu-ston Thams chas mkhyen-pa* retired to the mansion of purity (died). 1363
- Gser-gliñ-pa bkra-dpal* of *Sañs* died. 1364
- Byañ-Sems kun bssañ*, a pupil of *Rje* (*Tsoñ-khapa*), was born. *Orgyan ngon-po* of *Stag-luñ* died. *Bsam-gtan dpal* of the *Bkah-rgyud* school died. 1365
- Ston Sakya rgyan* of *Khañs rgyal-mo roñ* was born. The monastery of *Roñ-Byams chhen* was founded by *Sems-dpañ gshon rgyal*. 1366
- The Mongol emperor *Tho kwan themur*, having lost the throne, fled to Mongolia which he ruled over. *Huñ-Wu*, the founder of the *Tamiñ* dynasty, became emperor of China. *Gyuñ slon*, the predecessor of *Mkhas grub*, died. 1367
- The great *Tai Miñ* invited the sage (*sthávira*) *Chlu-hgram-pa* to China.
- Rgyal sras thog med* was born. 1368
- The twelfth *Gsarma* died. 1369
- Sgom-po chhos dvañ phyug* was born. *Ser-señ* of middle *Hbrug* was born. 1370
- Rje-blama* (*Tson-khapa*) proceeded to *Dvus* and *Gtsañ* (*Tibet proper*). 1371
- Hor ston nam mkhah dpal*, the abbot of the *Byañ-rtse* division of *Dgahldan*, was born.
- Rje-blama* (*Tsoñ-khapa*) visited *Hbri-gon* and *Bde-vachan*. 1372
- The *Vinaya* teacher *Grags-pa rgyal-mtshan* was born. 1373
- Sha-lu Legs rgyan* (*Khri-chhen*) was born. *Bo-doñ chhos*

rgyan Phyogs las rnam rgyal was born. *Blo grags* died at Snar-thaṅ. *Blama Dampa bsod rgyap* was born. 1374

Rje-blama collected the first series of his religious discourses. *Hjam bsam rdorje*, the *Rñiṅ-ma Lama*, died. 1375

Grags don-pa of *Suarthaṅ* was born. 1376

The monastery of *Stag-rtse rnam rgyal sgaṅ* was founded by *Mkhaḥ spyod dvaṅ-po* (a red-cap Lama). *Gyag-sde Pan-chhen* died. 1377

Hjam-dvyaṅs chhos rje bkraśis dpal ldan was born. *Stag luṅ Nam dpal* died. 1378

Spyan sna bsod. bssaṅ of *Phag-gru* was born. *Mkhan-po Yeśes bsod rgyam* died. *Dvaṅ Lo-cháva Byaṅ-rtse* died. 1379

Dpal ldan Don grub, also called *Stag-phru-gu S'ri*, a disciple of *Rje* (*Tsoṅ-khapa*), was born. *Chog-ro Nor-pa Kun-bssaṅ* of *Sa-skya* was born. *Kun-rgyan* of *Sa-skya rdsoṅ* was born. 1381

Byams chhen-chos rje of *Sera* was born. *Spyan sna dpal bssaṅ* of *Phag-gru* was born. *Guṅ Ru rgyan bssaṅ* of *Sera* was born.

Karma Rol rdorje died. 1382

The Indian Pandit *Pan-chhen Nags Rin* was born. *De-bshin gs'egs-pa*, the fifth *Karma hierarch*, was born. *Sākya rgyal-po*, the *Rñiṅma Lama*, who was the abbot of *Yaṅ rtse-ra*, was born. 1383

The red congregation hall of *Stag luṅ* was erected by *Dpal rtsegs*.

Dge legs dpal bssaṅ (*Khri-chhen mkhas grub-thams chad mkhyenpa*) was born. (He was the first of the line of *Pan-chhen Rinpo-chhes* of *Taśi-lhunpo*). *Thaṅ-stoṅ rgyal-po*, the physician, was born. 1384

Ku-jo rtogs ldan was born. *Karma Smras seṅ rtog ldan* was born. *Bsod rgyan*, the twenty-second *Phag-gru hierarch*, was born.

The shrine of *Mamo* in *Dgaḥ ldan* was founded by *Mkhaḥ spyod-pa*. The *Bshipa gsar-ma* of *Phag-gru* died. *Jonaṅ Phyogs legs rnam rgyal* died. 1385

CYCLE VII.

The monastery of *Sé-pyil* was governed by the earlier *Sākya bsod nam*s. 1386

Mus-chhen kun mchhog rgyan, the disciple of *Dorpa Kun bssaṅ*, was born. 1387

Khri Blogros chhos skyoṅ was born. 1388

Mkhan chhen Hjam-ye died. *Blo señ* died at *Hbrug Raluñ*. *Ripa gshon-nu rgyal mtshan* died. 1389

Dge-hdun grub, the first of the line of the (*Rgyal-va Rinpo-chhe*) *Talai Lamas*, was born. *Bsod nam rgyal-mtshan* of *Se-spyil-bu* was born.

Hjag-chhen Byams dpal of *Sañ* died. *Sañ Hbah-ra*, the pupil of *Ssur-phu* and disciple of *Spyân-sña Rin ldan*, died. 1390

Byañ-sems blo-rgyan, the 'disciple of *Rje blama* (*Tsoñ-khapa*), was born. *Hgos Lo-cháva* (*yiḍ bssañ rtse gshon-nu dpal*), the *Karma-Rāñ* abbot, was born. *Rje blama*, after being miraculously visited by *Hjam-ḍvyañs*, proceeded to *Bya-bral* in *Holkha*. *Ser señ* died at *Hbrug Raluñ*. 1391

Rdsiñ-phyi was repaired by *Rje-blama Tsoñ-khapa chenpo*. He was miraculously visited by *Hjigs-byed* at *Rgya sog phu*. *Gshon-nu yeśes* died in *Bya-yul*. 1392

Byañ-sems śer Ḍssañ of *Smad* was born. *Rje blama* (*Tsoñ-khapa*) met *Lho-brag-pa*. 1394

Rje blama founded the educational college of *Gñal*. 1395

Rin-señ of *Se-spyil-bu* died. 1396

Nam-mkhah dpal of middle of *Hbrug* was born. 1397

Bsod nams mekhlog grub of *Snarthañ*, who became *Mkha-grub's* disciple, and *Mkhan-chhen grub śer's* nephew were born.

The second *Miñ* emperor *Huñ-wu tsha* ascended the throne of China. 1398

Grags-pa dpal ldan of *Spas* and *Hdul-hdsin Blo-gras*, the disciple of *Dge-hdun grub*, were born. 1399

Bssod-pa dpal grub of *Snarthañ* was born. *Bsod nams rnam rgyal* of *Byams gliñ*, who taught asceticism to *Rje blama Tsoñ-khapa*, was born. *Lama kun* died at the monastery of *Snarthañ*. *Nam-mkhah rgyal mtshan* of *Lho-brag* died. 1400

Baso chhos kyi rgyal mtshan, the younger brother of *Mkhas grub rje*, was born. *Khri Blo gros brtan-pa* was born. *Spyan sña blo-gros rgyal mtshan* was born. *Dpal ldan ḍssañ-po* of *Hdul nag* was born. *Sans rgyas chhos kyi señ-ge* of *Sgampo* died. 1401

Byañ-chhub rgya-mtsho of *Stag-luñ*, the red-cap Lama, was born. *Ratna gliñ pa* of the *Rñiñ-ma* school was born. *Yunglo* became emperor of China. 1402

Chhos dvañ grags-pa of *Shañ Shññ* was born. 1403

Ser-abs Rin chhen, called *Stag Lo-cháva*, was born. *Mkhas grub rje* took the final vows of monkhood. *Dge-hdun grub* entered monkhood. *Mkhah Spyod'dvañ-po*, the *Shva-mar* (red-cap) Lama, died. 1404

• Chhos dpal yes'es, the third Shva dmar Lama and incarnation of Mkhah dvañ, was born. 1405

Mkhas grub Thams chad mkhyañ-pa became a disciple of Rje Tsoñkhapa. The fifth Karma-pa Lama proceeded to China. Spyan sña dpal bssañ of Phag-gru died. 1406

• Bkra-sis dpal hoñ of Stag-luñ was born. Emperor Tai Ming (Yunglo) invited Byams chen chhos rje, abbot of Sera, to China. Grags bsod nams died at Phag-gru. Chhos hbyuñ Rinchhen, the saint, died. 1407

Dpal bssañ of Se-spyil-bu was born. Tsoñkhapa founded the grand prayer meeting of Lhasa, called Monlam chhenpo, and founded the great monastery of 'Rivo Dgañ ldan rnampar rgyal vahi gliñ. Kunsrañ bsod rgyan died. 1408

Panchhen bssañpo bkra sis of Bkra sis lhun-po was born. Sakya Sri of Tsañ was born. Dge-hdun grub took the final vows of monkhood. Sakya bsod nams of Se-spyil-bu died. 1409

Sañs rgyas hphel, the Rab hbyams-pa (doctor of divinity) of Byams chhen, was born. 1410

Rje-btsun Reñ hdañ-va died at Shiñ shun. 1411

Ye-ses rinchhen died at Ibrug-Raluñ. 1412

Khri Smon Dpal legs blo was born. Gyag phrug sañs dpal of Sa-skya died. Lho Rin-po chhe grags yon died. 1413

Khri Yes'es bssañpo was born. Karma De-bshin gsegs-pa died. 1414

Mthoñ-va don-ldan, the sixth Karma hierarch, was born. Hjam dnyañs Chhos rje dpal founded the great monastery of Ibras spuñ. Da-puñ Bsod bssañ of Phag-gru died. 1415

Dge hdun bssañpo of Gtsañ gi khyuñ-po bya-brañ, the pupil of Baso, was born. The twenty-second hierarch of Phag-gru succeeded his predecessor. The historical work, called Chhos hbyuñ bstan-pa Gsal byed, was written by Don grub dpal of Kam kam. Rñiñ-ma Rin gliñ recovered some concealed religious works from underneath the rock of Khyuñ tshañ brag. 1416

Ñag dvañ grags of Stag-luñ was born. 1417

Kun dgañ don-hgrub, who founded Rgyud stod, was born.

The monastery of Sera theg chhen gliñ was founded by Sakya yeśes. Dharma Rinchhen became Tsoñkhapa's successor on the grand hierarchical throne of Dgañ ldan. Rje Tsoñkhapa returned to the presence of Maitreya Bodhisattva. 1418

Ser rgyan of Snarthañ was born. The monastery of Gsañ sñags mkhar was founded. 1420

Rje-nor bssañ rgya-mtsho was born. Rgyan-Bde founded the monasteries of Gnas thañ and Ssuñ-man of Me-rtog ldan. 1421

Gtsaṅ blo-gros, the pupil of *Dpaḥ ra*, died. *Grub Serabs* of *Snarthaṅ* died.

Chhos dvaṅ-phyug of *Sgampō* died. 1422

Grags éer (the second) of *Snarthaṅ* was born.

Lo-cháva Bsod nams rgyam was born. He wrote thirteen volumes. *Bkra śis dpal rtsegs* died at *Stag luṅ*. 1423

Mkhan-chen Dus Hkhor-va Rin 'rgyan was born. *Karma Mtshur-phu-pa* composed *Byed rtsis* and *Sa-byar Sgrub rtsis* and *Gssah gnas drug*.

Hāñshi, the fourth Ming emperor, ascended the throne of China. *Nam dpal* of *Hbrug Raluṅ* died. 1424

Pañchen nags kyi Rinchen first visited Tibet. *Bsson-te* became the fifth Ming emperor of China. 1425

Dpal-hbyor lhun grub of *Sera* (a native of *Gñal-ston*) was born. The sixteenth *Kulika*, named *Bhúpála*, ascended the throne of *Sambhala*. *Dpal ldan blo-gros* of *Sera* was born. *Sar Rinpochhe* died. 1426

Sakya mehhog ldan was born. *Rgyal dvaṅ chhos rje dpal* of middle *Hbrug* was born. *Rtogs ldan Hjam dpal 'rgya-mtsho* died. 1427

Blo bssañ grags-pa of *Hdar-ston* was born.

Hjam dvyāṅs Dgaḥ blo (*Legs-pa chhos hbyor*) was born. *Ser bssañ* of *Byañ-rtse* was born. *Mehhog lha* of *Rva stod* was born. *Goram bsod seṅ* was born. *Rtogs ldanpa's* incarnation, *Rgya sras ées rab hphel*, was born. *Bssañ dor kun-bssañ* of *Saskya* founded the monastery of *E-bam*. *Se-spyil bsod lhun* died. 1428

Bkra śis dpal hod-pa became abbot of *Stagluṅ*. *Bsod rgyan* of *Se-spyil-bu* died. 1429

Mkhas grub rje became the grand hierarch of *Dgaḥ ldan*. *Sañs rgyas rinchen rgyal mtshan*, the *Rñiñ-ma Lama* of *Ye-rtse*, died. 1430

Kun-dgaḥ rnam rgyal of *Thon-mi*, the disciple of *Panchhen Byams gliṅ*, was born. *Hbum phrag gsum-pa* of *Saskya* and *Kun-dgaḥ chhos bssañ* were born. 1431

Panchhen Ye-rtse of *Bkraśis lhunpo* was born. *Se-spyil-pa Sñan grags* was born. The monastery of *Rgyud smad* was founded by *Rje-seṅ*. *Bsod bssañ* of *Smyuṅ, Gnās* died. 1432

Mkhas grub rje wrote a commentary of the *Káalachakra* system. *Hdul hdsin grags rgyan* died. 1433

The monastery of *Nálendra* was founded by *Roñ-ston*.

The possession of *Gtsaṅ* passed to *Rin-spuṅ* from the hands of *Phag-gru*. 1434

The monastery of *Stag mo gliñ* was founded by *Muschhen Dkon mchhog rgyan*. The sixth Ming emperor *Tiñg-thuñ* ascended the throne. *Kun rgyan* of *Saskya Jong* died. 1435

The monastery of *Byams-pa gliñ* in *Chhab mdo* in *Khams* was founded by *Smad S'es rab bssañ*, the disciple of *Tsoñ-khapa*. 1436

The monastery of *Mdo Sñags gliñ* was founded by *Byañ Sems kun dgah*. *Mkhasgrub Chhos rje* died. 1437

Blo bssañ Nima, the *Dvon-po* (disciple) of *Tsoñ-khapa*, was born. The first *IIphag-pa-lha* of *Khams* was born. *Rje N'ag dvañ* of *Phag-gru* was born. The great chhorten of *Dpal lkhhor chhos-sde* of *Gyañ-tse* was built. 1438

Chhos skyoñ bssañ-po (*Shvalu Lo-cháva*) was born. 1439

Byañ Sems S'akya bsod nams of *Rva-sgreñ* died. 1441

Yon tan rgya-mtsho of *Thon-pa* was born. 1442

Bdag-chen Blo Rgyan of *Saskya* was born. *Byañ sems kun dgah bssañ* died. 1443

Don yod dpal ldan of *Sera* was born.

S'esrab seño 'of Snarthañ, who founded the *Rgyud grva tshañ* of *Gtsañ* and *Dvus*, died. *Gu-jo rtogs ldan* died. 1444

Kun dgah bde legs rgyan bssañ of *Gpas rñiñ*, who became *Baso's* disciple, was born. *Lhariba* of *Rgyud stod* was born.

Lha dvañ dpal lhyor was born. *lñog byañ dpal* died. 1445

CYCLE VIII.

Rinchhen Chhos rgyen (*Chhog Lo-cháva*) was born. The monastery of *Bkra-sis Lhun-po* in *Gtsañ* was founded. *Nam mkhah dpal* (*Hor-ston*, the Lama of the Mongols) died. 1446

Byañ Chhub rgya-mtsho (of the red-cap school) of *Stag luñ* died. 1447

Chhos rgyal bstanpa (*Rab lhyams-pa* or doctor of divinity) of *Dvagspo*, who was *S'ans rgyas kphel's* disciple, was born. *Kun hssañ Chhos ñam* of *l'do-rañ* was born. The monastery of *Skyid tshul* of *Hbras-yul* in *Sa-skya* was founded by *Sans kphel*, the *Rab lhyams-pa*. *IIjam dvyañs chhos rje* died.

Roñston died. 1448

Khri S'is dar legs blo was born. The seventh Ming emperor *Tsing-the* ascended the throne. *Legs rgyan* of *Shvalu* died. *Guñru rgyen bssañ* died. *Bodoñ phyogs las rnam rgyal* died. 1449

Grags rgyan Sgam Smyon of *Sgampo* died. 1450

Bsod nams mChhog grub of *Snarthañ* died. *Shva dmar Chhos dpal yeśes* died. 1451

Khri-pa Chhos bés was born. Khri-pa Rin hod was born.
 Chho Grags Yeśes, the fourth Shva-dmar Lama, was born.
 Pañchhen Nags rin visited Tibet. Karma Mthoñ-va Don ldan
 died. Rimi h̄bab-pa died. 1452

Sgampo bsod rgyan was born. The seventh Karma hier-
 arch Chhos Grags rgya-mtsho was born. 1453

Phyogs las rnam rgyal and Chhōs dvañ Lhun-grub were
 born. 1454

Kun-bssañ of Ñor was born. 1455

Grub Chhos rdorje was born.

Bkra-sis dpal, the Tantrik saint of the Karma school, was
 born. The eighth Ming emperor T'hen-srun ascended the
 throne of China. Byañ sems ser bssañ of Smad died. 1456

Chhos ldan blo gros of Rgyud stod was born. Panchhen
 Ñag dvañ grags-pa was born at Sñiñ. 1457

The second Sakya bsod nams of Se-spyil was born. Bkra
 sis dpal of Stag luñ died. 1459

The second Bkra dpal of Stag luñ was born. Sñan grags
 of Se-spyil died. 1460

Baso Chhos rgyan became the grand hierarch of Dgah-
 ldan. Khri Blo gros Chhos skyoñ died. 1462

The monastery of Goñkar Rdorje Gdan was founded by
 Thon-me kun dgah. 1463

The monastery of Skyo mdah dgonpa was founded by Hgro
 mgon Blo gros bssañpo of Skyo mdah in the eighth year of his
 age. The ninth Ming emperor Hwa ascended the throne of
 China. 1464

Blogros rgyal-mtshan founded the monastery of Ñi-stiñ.

Stag Phrugu Srí died. Lo-chhuñ Dkañ bshi-va died. 1465

Grags don of Snarthañ died. 1466

Panchhen Nags rin died at Palpo in Nepal. 1467

Btsun-pa Chhos rgyan of Sera was born. Rnam rgyal
 Grags-pa of Stag-luñ was born. The monastery of Gser-mdog
 chan was founded by Sakya mchhog. Mus-chhen Dkon rgyan
 died.

Rje druñ Chhos dvañ Grags of Shañshuñ died. 1468

Bssañ dpal died at Snarthañ. Blo rgyan (Sems-Dpah
 chhen-po) of Bdenø thañ died. 1469

Smon lam blo gros, the first embodiment of Sems dpah of
 Bdemo thañ, was born. 1470

Bsod nams dpal bssañ of Stagluñ was born. The monastery
 of Grva Byams gliñ was founded by Thumi Lhan bkras. Spyan
 Sña blo rgya-mtsho died. 1471

• Khri Chhos Skyon rgya-mtsho was born. Lha Chhos bssañ of Se-spyil was born. Blo brtan became the grand hierarch of Dgah ldan. The monastery of Thub-bstan rnam-rgyal was founded by Karam-pa. Baso Chhos rgyan died. Hdul nag-pa of Snar thañ died. 1472

• Dge hdun grub died, and Panchhen Bssañ-po bkra śis became abbot of Bkra śis lhunpo. Rñiñ-ma S'akya rgyal died. 1473

Dge hdun rgya-mtsho, the second embodiment of the Rgyal-va Rin-po-chhe, was born.

Blo gros Grags dpal (Hdul hdsin) died. Byams pa Gliñ-pa died. 1474

Ssla-ya rgyal mtshan of Stóñ skor, an incarnation of Hdul hdsin grags rgyan, was born. Kun dpal of Hbrug-pa school died. 1475

Kun dgah legs blo of Sgom-rum was born. 1476

Khri-pa Panchhen bsod Grags, an incarnation of Bu-ston, was born. Bssañ bkra having died, Luñ rig rgya-mtsho became abbot of Bkraśis lhunpo. Ko-ram bsod Señge founded the monastery of Thub-bstan rnam rgyal glin. Khri Blo brtan died. 1477

Ssur-mañ Bya btañ-pa was born. At the sixty-first anniversary of Tsoñkhapa, a religious controversy took place at Rtse-sar. 1478

The Rtse śar controversy having terminated, Smon lam dpal became the grand hierarch of Dgah ldan. 1479

The Lama Shva dmar led the Tsañ army to Dvus. Hgos Lo-cháva Gshon-dpal died at Yid rtse. 1480

Nag-dvañ Hjigs med Grags of Rin spuñ was born. Lo-cháva bsod rgyam was born. 1481

In the sacred chronology of Nor bssañ rgya-mtsho the 712th year of the second age expired. 1482

Byams Chhen Rab hbyams died. 1484

Talai Lama Dge-hdun, rgya-mtsho entered monkhood. Grags śes rab became abbot of Snarthañ. Kungrul of Rgyud stod died. 1485

Dpal bssañ of Se-spyil died. Hphags-pa lha of Khams died. 1486

Sgam-po bsod lhun died. Huñti, the tenth Ming emperor, ascended the throne of China. Sgam-po bsod rgyan died. 1487

Lo-cháva Rinchhen bssañ of Shvalu was born. The monastery of Nan yod śaśs chhos sde of Sa-skya was founded by Hbum phrag gum-pa. Gor rampa Bsod Señ of Sa-skya died. 1488

Blo bssañ Nima became grand hierarch of Dgah ldan. The

monastery of Thub-bstan Yañs-pa-chan was founded by Rab
hbyams-pa Thug-rje dpal of Mus. 1489

Khri Mi ñag rdorje bssañ-po was born. Khri Smon lam
dpal died. 1490

Khri-pa Dvon-po Blo bssañ Ñima died. 1491

Khri Chhos grags bssañpo was born. Khri Dge-hdun
bstan-dar was born. 1492

The work, called *Bkah gdams' Chhos hbyuñ Gsal sgron*, was
written by Las Chhen kun dgah rgyal mtshan. 1493

Kuñ dgah Grol mchhog, the head of the Jonañ school, was
born. 1494

Thonmi Kundgah rnam rgyal died. Kundgah bde legs of
Gnas rñiñ died. Ñag Grags of Stag-luñ died. 1495

Khri rgyan bssañ was born. 1496

Rinchhen Spuñpa of Gtsañ, after taking Snehu rdsoñ, took
possession of Spyid S'añ.—At the grand annual prayer meet-
ing (Monlam Chhenpo) of Lhasa the Lamas of the Gsañ-phu
and Karma schools humiliated those of the Sa-skya-pa and
Hbras spuñ schools. Khri ve bssañ died. 1497

Karma Grub thob Bkra dpal of Gñan founded the hermit-
age of Orgyan Rikroñ. 1498

Hdarston became grand hierarch of Dgah ldan. Panchhen
mchhog Lhapa died. 1499

Khri ñag dvañ Chhos Grags was born. 1500

Blo gsal rgya-mtsho of Tshar-chhen was born. Sgom-
smyon died. 1501

Hjam dgah blo died. Kun dgah Chhos bssañ, the abbot of
Skyid tshal, died. Dpah-po Chhos dvañ Chun Grub died. 1502

The second Dpah-po Gtsug-lag phreñ-pa, the astrologer and
chronologist, was born. Hbum phrag, Gsum-pa of Sa-skya,
died. 1503

Khri Dge-legs dpal of Hol dgah was born.

The third incarnation of the Panchhen Rin-po chhe, named
Blo bssañ don grub, was born.

The sage Phyogs las rnam rgyal was born. Tiñ-te, the
eleventh Ming emperor, ascended the throne. 1504

Karma Chhos Grags rgya-mtsho died. 1505

CYCLE IX.

Mi bskyod rdorje, the eighth Karma hierarch, was born.
Sañs rgyas dpal, the second incarnation of Hphags-pa lha Khams,
was born.

Ser-bssañ died at *Byañ rtse*. *Sākya mchhog* of *Sa-skyā* died. 1506

The second *Bkra dpal* of *Stag-luñ* died. 1507

Dge-hdun rgya-mtsho founded the monastery of *Chhos hkhor-rgyal* in the plain of *Rgyal Metog thañ*. 1508

Chos Idan blo gros of *Rgyud stod* died. *Khri Hdar Ston blo bssañ grags-pa* died. 1510

Blama rinpochhe Dge-hdun rgya-mtsho became the grand hierarch of *Bkra śis lhunpo*. 1511

Panchhen Bkra śis nam rgyal of *Sgampo* was born.

Mkhas grub Nor-bssañ rgya-mtsho was born. 1512

Dpal-blo of *Sera* died. 1513

The *Panchhen* died at *Sñug*. 1514

Khri Byams-pa rgya-mtsho was born. *Bsodnams Dvañ rgyal* of *Sgampo* was born. *Lharipa* of *Rgyud stod* died. 1515

The grand Lama *Dge-hdun rgya-mtsho* became abbot of *Hbras spuñs*.

Khri Rin hod-pa wrote a treatise on the chronology of the Buddhists. 1516

The power of *Gtsañ-pa*, having waned since the year *fire-mouse*, the monasteries of *Sera* and *Hbras spuñ* recovered their place in the *Moulam Chhenpo*, the grand prayer assembly of *Lhasa*. 1517

Thub dvañ bstan ldsin of *Sgampo* was born. *Kun-dgañ dpal* of *Ñañ*, who was born in the year *fire-ox*, became abbot of *Chhab-mdo*. 1518

Khri Tshe-brtan rgya-mtsho was born. *Bsod dpal* of *Stag luñ* died. 1519

Grub-chhen Chhos rdorje made over the book of miraculous revelations of *Tsoñ khapa* to the *Talai Lama Blo-bssañ Don grub*. *Thon-pa Yon-rgya-mtsho* died. *Grub thob* of *Gñan*, having died, was re-born in the same year. 1520

Kya-Jiñ, the twelveth Ming emperor ascended the throne of China. 1521

Khri dam Chhos dpal hbar was born. 1522

Hjam dvyhñs mkhyen brtse dvañ phyug was born.

Rnam rgyal bkra śis of *Stag luñ* was born. *Don yod dpal Idan* of *Sera* died. *Chhos kyi Nima* of *Rdo-roñ* died. *Rab bbyams-pa* of *Dvags-po* died. *Chhos Grags Yeśes* of the *Shva-dmar* school died. 1523

Mkhas grub Sans rgyas Yeśes was born. *Dkon mchhog yanlag*, the fifth *Shva dmar* hierarch, was born. 1524

Khri Dpal hbyor rgya mtsho was born. Metri Dongrub rgyal mtshan of Bod mkhar was born. 1525

Bsod nams Chhos hphel of Dgon Gsar was born. Hbrug-pa Padma dkarpo, the great antagonist of Tsoñkhapa, was born. The sixteenth Kulika (fabulous emperor), named Dpal skyoñ (Sri-pála), ascended the throne of Sambhala. The great Shalu Lo-cháva was born. 1526

Bsod Grags-pa became the grand hierarch of Dgañ ldan, and wrote the Buddhist historical work called Bkañ gdan Chhos hbyuñ. 1528

Khri Sesrab legs blo died. Rnam rgyal Grags-pa of Stag luñ died. 1529

The foundation of the monastery of Phan bde dgon was laid by Sans rgyas bkra śis, the father of Hphags-pa lha the second. 1530

Khri Dge hdun rgyal mtshan was born. Sgom lde rnam rgyan of Rgyud stod Sar-va was born. 1531

Rgyal mtshan bssañ-po became abbot of Rgyud-smad. 1532

Spañ dkar Rinpoche was born. 1533

Tharpaki rgyal mtshan, also called Naga grub-chen, was born.

Chhos rgya-mtsho became the grand hierarch of Dgañ ldan. 1534

Kun-bkra of Stag luñ was born. The work on astrology and astronomy, called Rtsis gshuñ, was composed by Gtsugla phreñ-va. 1535

Rje-druñ Lha dvañ Chhos rgyan, the incarnation of Baso Chhos rgyan, was born. The abbotship of Sera was filled by Rje btsun-pa. The Hbriguñ authorities dispossessed the Dgo ldan-pa hierarch of eighteen communities, Hod sna &c. 1536

Rdor bssañ of Miñag became the grand hierarch of Dgañ ldan. Khri Chhos skyoñ rgya-mtsho died. Karma Hphrin las pa died. 1538

Khri Sans-rgyas Rinchen was born. Khri-pa Chhos bses died. Khri-pa Rin hod died. Bya btañ of Ssur mañ died. 1539

Rnam rgyal Dpal bssañ of Rgyud Smad was born. Mkhan chhen nam rgyam was born. The monastery of Mñak ris Grva-tshañ was built on a hill near Rtse-thañ. 1540

The Talai Lama Dge-hdun rgya-mtsho died. 1541

The third Talai Lama Bsod nams rgya-mtsho was born. 1542

The monastery of Phan bde Gñiñ was founded. Kun legs of Sgom rum died. 1543

Khri Chhos ñer Grags was born. Khri Blo rgyam of Stag

luñ Brag was born. Khri Damchhos dpal was born. Rje
btsun-pa died. The monasteries of Tshal Guñthañ and Stag
luñ lha khañ were destroyed by fire. 1545

Rje-druñ Ser dvañ founded the monastery of Dar rgyas in
Kham. Nag dvañ Chhos Grags became grand hierarch of
Dgañ ldan. 1547

Rje bsod nam rgya mtsho entered monkhood. 1548

The monastery of Bshad sgrub gliñ in Kham was founded
by Baso sprul sku. Rnam rgyal Phun-tsho became abbot of
Stag luñ. 1549

Khri Nag-dvañ Chhos Grags died. 1550

Chhos Grags bssañ-po became grand hierarch of Dgañ
ldan. Sgampo Bsod lhun died. 1551

Mi Gyo Sñiñ-po (Rje-druñ tsha-wa-pa), who was born in
the year *fire-serpent*, was appointed to the abbotship of Chhab-
mdo. Sems dpah Smon lam Blo gros died. Sgam-po bsod
nam Dvañ-rgyal died. 1552

The second incarnation of Sems-Dpāñ, named Nag dvañ
Grags rgyan, was born. Khri Bsod nam Grags-pa died. Khri
Miñag Rdor bssañ died. Karma Mi bskyos rdorje died. 1553

Khri-pa Grags-pa rgya-mtsho was born.

Khri-pa Grags-pa rgya-mtsho was born. Kun-bkra Lo-
cháva filled the abbotship of Stag-luñ. His father Sañs bkra
died. 1554

The ninth Karma incarnation, named Dvañ-phyug-rdorje,
was born. The first incarnation of Bsod nam Grags-pa, named
Bsod nam ye dvañ, was born. Stoñ skor Ssla rgyan died. 1555

Yontan rgya-mtsho of Stoñ-skor was born.

Dge-hdun bstan rgyam, the incarnation of Rje-druñ Sñags
ram-pa (Dge-Bkrañs), was born. 1556

Dge-legs dpal of Hol dgañ became grand hierarch of Dgañ
ldan. Dvañ phyug rab-ñrtan of Gnas gsar was born. Bsod
nam rgyam-tsho became the abbot of the Sora monastery. 1557

Dkon-mchhog rgya-mtsho of Sro (Hre) rgyud monastery
was born. Bdag Chhen Bsod dvañ was born. Khri-pa Chhos
Grags bssañ-po died. 1558

Rje druñ Sesrab dvañ-po of Rgyañ Sod held the abbot-
ship of Chhab-mdo. 1559

Khri-pa Tshul Khri-m Chhos kphel was born. 1560

Thub-dvañ bstan ldsin of Sgampo died. 1561

Shva lu Locháva Riñ-bssañ died. Rnam Bkra of Stag luñ
died. 1562

The incarnate Lama Sans³ rgya ohhos hdsin was born. Bsod nams rgya-mtsho took the final vows of monkhood. Dge-hdrun bstan dar became the grand hierarch of Dgah ldan. 1563

Tshe bñtan Rdorje pha gus of Gtsañ became master of the province of Gtsañ. Panchhen Blo-bssañ Don Grub died. 1564

Sesrab Phun-tshogs of Rgyara was born. Gtsug-lag hphreñ-va died. Kun dgah Grol Chog died. Hphags-pa Sans rgyas died.

Panchhen Rnam tharma Blo-bssañ Don Grub died. 1565

CYCLE X.

The third incarnation of Hphags-pa Lha, named Mthoñva don ldan bsod nams rnam rgyal dvañ po hi sde, was born. The eighteenth Ming emperor Hwañ-ti ling Chhing ascended the throne of China. Khri Dge legs dpal died. Tshar-Chhen blo gsal died. 1566

The third Dpah-vo Karma Stsug lag rgya-mtsho was born. Tshe-rten rgya mtsho became grand hierarch of Dgah ldan. Khri Dge hdun bstan dar died. 1567

Chhos rgyan of the Gnas rñiñ monastery became abbot of Bkra sis lhunpo. 1568

The fourth Panchhen (Taśi Lama) Blo bssañ Chhos kyi rgyal mtshan was born. Ser dvañ became abbot of Chhah mdo for the second time. A dispute between Hbri Guñ and Stag luñ took place. 1569

According to his biography Panchhen Blo bssañ Chhos rgyal mtshan was born in this year. 1570

Sgampo Khri-pa Bkra Sis kun Grags was born. Mkhanpo Ñag dvañ Chhos Grags was born. At Skyid Soñ the Phag-gru dispute took place. Sems dpah sprul sku Grags rgyan died. 1571

Khri Dkon mchhog Chhos hphel of Gliñ Smañ was born. The third embodiment of Sems dpal sprul sku Ñag dvañ Chhos rgya mtsho was born.

The fourteenth Ming emperor Wan li Siñ kya ascended the throne of China. 1572

Sar-va nam rgyan-pa governed Rgyud stod. Talai Lama Bsod nams rgya-mtsho founded on Potala the monastery of Rnam rgyal Grva-tshañ which afterwards was converted into a Bñiñ ma institution. 1573

Gsal khañ sprul sku Chhos rgyan, who was an incarnation of Khri Dhag-dvañ Chhos Grags, was born. Lama Tāránátha Kun Sñiñ of the Jonañ school was born. Byam-rgyam became

the grand hierarch of *Dgaḥ ldan*. The armies of *Rin spuñ*, after invading *Dvus*, returned to *Gtsaṅ*. 1574

Khri Tshe brtan rgya-mtsho died. *Talai Lama Bsod nams rgya-mtsho* proceeded to Mongolia. 1576

Bstan hdsin phun tshogs of *Mgar dam* was born. The monastery of *Sku-kbum* (*Kumbum*) was founded at the birth-place of *Tsoñ-khapa*. *Althan Khan* received the *Talai Lama Bsod nams rgya-mtsho*, who in the following year founded the monastery of *Theg Chhen Chhos khor gliñ*. 1577

Baso Lha dvañ became abbot of *Chhab mdo*. According to the directions of the *Talai Lama Bsod nams rgya-mtsho*, the incarnate *Lama Bsod nams ye dvañ* founded the monastery of *Thub-chhen Chhos khor* of *Sbom hbor* in *Lithañ*. 1579

Talai Lama Bsod nams rgya-mtsho visited *Chhab mdo*. Internal disputes raged at *Hbriguñ*. 1580

Sans rgyas yeśes gave the vows of monkhood to *Panchhen Rinpoche*. *Dpal hbyor rgya-mtsho* became the grand hierarch of *Dgaḥ ldan*. *Guśri Khan* of *Hor* was born. 1581

Dkon mehhog yan lag the *Shva-dmar Lama* died. 1582

The sixth *Shva-dmar Lama*, named *Gar dvañ Chhos kyi dvañ phyug*, was born. 1583

The abbot of *Stag luñ*, named *Ñag dvañ rnam rgya*, became abbot in the 15th year of his age. 1584

Mkhas grub Hphags-pa Sakya lha dvañ was born. 1585

Sgam-po Bkraśis rnam rgyal died. *Bod mkhar Don-grub* died. 1586

Hjam dvyañs rgya-mtsho and *Rgyal-va rgya-mtsho* of *Stod skor* were born. *Talai Lama Bsod nams rgya-mtsho* died. 1587

The fourth *Talai Lama Yon-tan rgya-mtsho* was born in Mongolia. The *Dgaḥ ldan* abbotship was held by *Dam-ghhos* of *Dpal hbar*, and the *Rgyud smad* hierarchical chair was filled by *Rnam rgyal dpal bssañ*. 1588

Blo bssañ rgya-mtsho, the physician of *Gliñ Stod* in *Gsañ-phu*, was born. *Khri Byams rgya-mtsho* died. *Mkhas Grub Sans rgyas Yeśes* of *Dven-sa* died. 1589

Dge-hdun bssañ rgya-mtsho, the incarnation of *Khri Byams*, was born. *Blo bssañ Ñag dvañ* of *Sgo-mañ* was born, at *Bsam grub sgañ*.

The *Panchhen Rinpoche* took the final vows of monkhood. 1590

Yeśes rgya-mtsho, the first incarnation of *Sans rgyas Yeśes* of *Dven-sa*, was born. *Sar-va Nam rgyan* of *Rgyud Stod* died. The incarnate *Lama Bsod nams ye dvañ* died. 1591

- The *Hbrug-pa* Lama *Dpag bsam dpañ-po* was born. 1592'
- Bsod nams dge-legs*, the second incarnation of *Bsod nams Grags-pa*, was born. *Hphags-pa mthoñ-va-don ldan* held the abbotship of *Chhab-mdo*. *Guśri* of *Hor* overrun *Mgo dkar*. 1593
- Blo mChhog rdorje* of *Sman luñ* was born. *Dpon* (Governor) *Bsod nams Chhos hphel*, also called *Rab brtañ*, was born. 1594
- Da-yan Khan*, son of *Guśri Khan*, was born. *Sans rgyas Rinchen* filled the grand hierarchical throne of *Dgah ldan*. 1595
- Kun dgah bsod nams* the *Bdag chhen* (hierarch) of *Saskya* was born. 1596
- Khri Dpal hbyor rgya-mtsho* died. *Khri Dam chhos dpal hbar* died: The abbot of *Sgampo*, *Bkra sis Kun grags*, died: *Kun bkra* of *Stag luñ* died. 1598
- The *Panchhen* ascended the throne of *Bkra sis-lhunpo*. *Mkhan chhen nam rgyan* died. 1599
- Chhos hbyor rgya-mtsho*, the incarnation of *Khri dpal rgyam*, was born at *Thañ-riñ*. *Karma Dvañ phyug rdorje* died. 1600
- Khri Nam dag rdorje blo bsañ don yod* was born. *Dkon mchhog yar hphel* of the *Sre rgyud-pa* monastery was born. *Bsod nams mchhog grub* of *Shvalu* was born. *Rnam rgyal dpal bsañ* of *Rgyud smad* died. 1601
- Mkhan-po Bsod nams mchhog grub* was born. *Ñag rgyan* became grand hierarch of *Dgah ldan*. The *Talai Lama Yontan rgya-mtsho* was brought to Tibet from *Hor*, and being given the vows of monkhood by the retired hierarch of *Dgah-ldan*, presided over the monasteries of *Hbras spuñ* and *Sera*. 1602
- The tenth *Karma hierarch Chhos dvyins rdorje* was born.
- Chhos dvyins rañ Grol*, the *Rñiñ-ma Lama*, was born. *Rgyal sras Don rgyan-pa* founded the *Dgon-luñ* monastery of *Amdo*. *Sems dpah Ñag dvañ Grags rgyan* died. *Yeses rgya-mtsho*, the incarnate Lama of *Dven-sa*, died. *Baso Lha-dvañ* died. *Hphags-pa mthoñ-va don ldan* died. 1603
- Ñag dvañ phun-tshogs rnam rgyal*, the incarnation of *Sems dpah*, was born.
- Blo bsañ bstan ldsin rgya-mtsho*, the second incarnation of *Dven-sa*, was born. *Chhos kyi rgyal-po rnam Rgyal rgya-mtsho*, the fourth incarnate *Hphags-pa* of *Khams*, was born. *Baso-Rje-druñ* (*Lha-dvañ chhos dvan phyug*) died. The fort of *Skyi-śod sgar* was destroyed by the *Karma* armies. *Chhos rgyan*, the incarnate *Sems dpah*, died. 1604
- Guśri Khan* effected a reconciliation between the *Oe-loth* and *Khalkha Mongols*, who were quarrelling on account of a

question of precedence between the grand hierarchs of *Dgah ldan* and of *Stoñ skor shabs druñ* named *Rje-btsun dam-pa*. For this service he received the title of *Guśrí*. 1605

The fourth incarnation of *Sems dpah* *Ņag dvañ* *phun-tshogs rnam rgyal* was born. The grand hierarchical throne of *Dgah ldan* was filled by *Chhos űer*, also called *Bśes gñen grags*. *Khri Dge-rgyan* died. 1606

Táránátha wrote his *Rgya-gar chhos* *lbyuñ* "Rise and progress of Buddhism in India." 1607

Spañ dkar Rinpoche died. 1607

Dkon-mchhog rgyal mtshan, of the monastery of *Sre-rgyud* near *Bkraśis lhunpo*, was born. *Dam chhos rgya-mtsho* of *Pa-chhe*, the teacher of *Sumpa*, became abbot of *Stag-luñ*. *Ņag dvan rnam rgyal* of *Stag luñ* wrote the work, called *Chhos-lbyuñ* (history of Buddhism). 1608

Bkra-śis grags rgyam of *Sgampo* was born. *Don yod chhos kyí rgya mtsho*, the incarnation of *Rgyal sras*, returned to *Dvus*. The armies of *Gtsañ* invaded *Dvus* and withdrew. 1609

The *Grva-tshañ* monastery of *Amdo* was founded by *Likya Ser mchhog*. 1610

Hdul-va chhos rje hod rgyam-pa reduced the monastery of *Sku-lbum* into a *Gtsañ* institution. The *Karma* hierarch *Phun-tshog rnam rgyal* became the lord temporal and spiritual of *Gtsañ*. *Khri Sans rin* died. 1611

The *Panchhen Rinpo-chhe* presided over the *Monlam chhenpo* (prayer congregation) of *Lhasa* between this and the year *earth-horse*. 1612

Talai Lama Yonton rgya-mtsho took the final vows of monkhood from the *Panchhen Rinpo-chho*. 1613

Blo rgya-mtsho of *Stag brag* filled the grand hierarch's chair of *Dgah ldan*. *Phun-tshogs rnam rgyal* of *Gro-tshañ ka riñ* became abbot of *Dgon luñ Byams gliñ*. The incarnate Lama *Bsod nams dge legs dpal* died. 1614

Talai Lama Yonton rgya-mtsho died. 1615

Talai Lama Ņag dvañ blo bssañ rgya-mtsho was born. The *Panchhen Rinpo-chhe* became abbot of *Hbrags spuñ*.

Bkra-śis Phun-tshogs, also called *Lha-pa chhos rje*, held the abbotship of *Dgon luñ*. *Yap Sans rgyas chhos hdsin* died. 1616

Khri Byams bkra was born. The incarnate *Yap Lama Sans ye* was born. *Dam chhos dpal* filled the grand hierarch's chair at *Dgah ldan*. The *Gtsañ* army besieged *Sera* and *Hbras spuñ*, and killed many thousand monks. *Khri chhos űer grags* died. *Khri Blo-rgya-mtsho* died. 1617

The third incarnation of *Bsod grags*, called *Grags rgyan* of *Gssims khañ goñ-ma*, was born. *Chhos hbyor rgya-mtsho*, the incarnate *Lama* of *Thañ-riñ*, died. 1618

Bsod nam *chhos hphel* filled the grand hierarch's chair at *Dgañ-ldan*.

The Mongol and *Gtsañ* armies fought with each other at *Rkyañ thañ sgañ*, where many Tibetans fell. 1619

Khri Dam chhos dpal died.

Sumpa slo-dpon-pa chhe-va a second time held the abbotship of *Dgon luñ*. The fifteenth Ming emperor *Then-chhi* ascended the throne of China. The Mongols defeated the *Gtsañ* armies at *Rkyañ thañ sgañ*, and thereby restored lost territories to *Dge-grags-pa*. 1620

The Mongol *Hphrin las lhun-grub*, also called *Smin grol* *Nomen khan*, was born. *Talai Lama Blo bssañ rgya-mtsho* became abbot of *Hbras spuñ*. 1621

The *Panchhen Rinpoçhe* erected the golden spire of the shrine of *Behug-chig-shal*. *Grags rgya-mtsho* became the grand hierarch of *Dgañ ldan*. After his death the hierarchal chair was nominally filled by *Ñag dvañ chhos rgyan*.

Khri-Tshul Khriims chhos hphel died. 1622

Talai Lama Blo bssañ rgya mtsho took the final vows of monkhood. 1623

Dkon mchhog chhos hphel became the grand hierarch of *Dgañ ldan*. *Panchhen* became the abbot of the *Byan rtse* college. 1625

CYCLE XI.

The eighteenth *Kulika* emperor ascended the throne of *Sambhala*. *Hjam-pa chhos rje* (*Chhos rgya-mtsho-va*) became abbot of *Dgon luñ*. 1626

This year a little decrease was observed in the solar brightness, and there being an entire eclipse of the moon, the whole phenomenon was considered as ominous by *Dpal lhun* of *Pha boñ kha*. The sixteenth Ming emperor *Khuñ-tin* ascended the throne of China. *Dkon-mchhog rgya-mtsho* of the *Sre rgyud* monastery died. 1627

Panchhen chhos rgyan built a gilt dome on the monastery of *Dgañ ldan*. 1628

Lchañ skya Ohhos rje grags-pa hod sser became abbot of *Dgon-luñ*. 1628

The monastery of *Roñ-po* was founded by *Skal ldan rgya-*

mtsho, also called *Roñ-po grub chheñ* of Amdo. The *Shva dmar Lama Gar-dvañ* died. *Dpah-vo Gtsug lag rgya-mtsho* died.

1629

The seventh *Shva-dmar* hierarch was born.

1630

Khri Chonas-pa was born. *Rgya-ra S'esrab Phun-tshogs* died.

1631

Sumpa Slo-dpon-pa Dam-chhós rgyal mtshan became abbot of *Dgon-luñ*.

1632

The incarnation of *Sgampo*, called *Nor rgyan*, died.

Khri Blo gros rgya-mtsho was born. *Blo bssañ bstanpañi rgyal mtshan* was born.

1634

Sgampo Bkra śis grags rgyam died.

1635

Ldan-ma smon lam rab hbyor-pa (*Tshul-khrims rgya-mtsho*) became abbot of *Dgon-luñ*. *Guśrí chhos rgyal* entered *Kokonur*, and defeating the armies of the *Khalkha* tribes who were inimical to the *Dgelug-pa* school, proceeded towards *Dvus*, from which place he returned to *Kokonur*.

1636

Hkhon-ston dpal lhun died.

Bstan hdsin legs bsad of *Koñ-po* became hierarch of *Dgañ ldan*, but he could not long hold the office and was obliged to resign it. *Rje-Dge rin* succeeded him. The *Talai Lama* and the incarnation of *Gssim khañ Goñma* took the special vows of *Smañ hdul dge sloñ* from *Panchhen thams chad mkhyen-pa*.

1637

Ñag-dvañ bstan Hdsin Hphrin las (*Skyid soñ shabs druñ*) was born. *Rnam rgyal dpal hbyor* (*Chhos-bssañ sku goñ-ma*) became abbot of *Dgon-luñ*. *Guśrí chhos rgyal* subdued *Beri*, the chief of *Khams*, and annexed his possessions.

1638

S'akya lha dvañ wrote the historical work, called *Chhos Hbyuñ*. King *Beri* of *Khams*, being a follower of the *Bon* religion, was declared a common enemy of the *Buddhist* religion. He was thrown into prison and punished with death.

1639

Mkhan-po Ñag dvañ chhos grags died.

1640

Lchañ skya Ñag dvañ chhos ldan dpal bssañ-po was born.

Hphags shi-va bssañ-po, in the 44th year of his age, became abbot of *Chhab mdo*. *Guśrí khan* entered *Gtsañ* and captured the king of *Gtsañ* and annexed *Gtsañ koñ* to his dominions. He was proclaimed king of *Tibet*. The governor *Bsoñ nams chhos phel* became regent.

1641

Blo-bssañ bstan hdsin Hphrin-las of *Khalkha* was born.

Bstan-pa rgyal-mtshan of *Dvags-po* became hierarch of *Dgañ-ldan*.

1642

Hphags-pi chhos rgyal died.

- Rgyal-va rgya-mtsho*, the fifth incarnate *Hphags-pa* of *Khams*, was born. Six great nobles of China conspired against the emperor *Khrūn tin*, and their leader usurped the imperial authority for a fortnight, after which the Manchu chief *Sun-t'i Chhi-the tsuñ* took possession of the imperial crown. 1643
- The famous palace of *Potala* was built. 1644
- The monastery of *Ma-mgur* in *Amdo* was founded by *Lamo sprul sku Blo-gros rgya-mtsho* and *Hod sser bkra śis*. *Khri dkon mchhog-ohhos hphel* died. 1645
- Khri Dvags po* died. 1646
- The spiritual teacher of the author (*Sumpa mkhanpo*), named *Hjam dvyāñs-bshad-pa* (*Ņag-dvañ brtson grus*), was born. *Dkon-mchhog chhos bssañ* filled the hierarchical throne of *Dgañ ldan*. *Hor Don grub rgya-mtsho* became abbot of *Dgon-luñ*. 1647
- The abbot of *Sgo-mañ*, named *Bsam grub Sgañ-pa Ņag dvañ blo bssañ dvyiñ chhos*, became abbot of *Dgon-luñ*. He afterwards accepted the abbotship of *Rva-sgreñ* in *Dvus*, in consequence of which *Don yod rgyal mtshan* of *Hor duñ* succeeded him in the *Dgon luñ* abbotship. 1649
- Legs rgya-mtsho* established a *Tantrik* school in the monastery of *Sku-hbum*. The monastery of *Dgañ ldan Dam chhos gliñ* of *Btsan-po* was founded by the retired abbot of *Dgon luñ* at *Sser khog*. 1650
- The *Talai Lama* visited *China* (*Peking*), and was there decorated with the insignia of *Tai Sri* by the emperor *Shun-t'i*. 1651
- The *Sde-srid* (viceroy) *Sansrgyas rgya-mtsho* was born. *Hod Sser Bkra śis* held the abbotship of *Dgon luñ*. The *Talai Lama*, on his return journey from *China*, visited the monasteries of *Dgon-luñ*, &c. 1652
- Dpal ldan rgyal mtshan* filled the chair of the grand hierarch at *Dgañ ldan*. 1653
- Guśri khan* died. 1654
- Emperor *Khang-shi* (*Bde-skyid*), known to the Tibetans as an incarnation of *Grags rgyal mtshan*, was born. *Sakya Lha Dvañ* died. 1656
- Tharpa Chhos rje* (*Bkra śis rgyal mtshan*) became abbot of *Dgon-luñ*. 1659
- The *Rñiñ-ma Lama* (*Ssur-chhos dvyiñs Rañ-grol*) died. 1660
- Guśri's* son *Ta-yan khan* became king of *Tibet*. *Hphrin las rgya-mtsho* became *Sde-srid* (viceroy).
- Don-yod chhos grags* of *Lu-hukya* became abbot of *Dgon-luñ*.

Blo-bssañ rgyal-mtshan filled the throne of *Dgañ ldan*.

The second Manchu emperor Kang-shi (*Shiñ-tsu*) ascended the throne of China. Panchhen *Blo-bssañ chhos rgyan* died at *Nag-ssla*.

1661

The fifth Panchhen Rinpoche (*Blo-bssañ yeśes dpal bssañ*), who was *Sumpa mkhanpás* spiritual guide, was born. *Sgo-mañ Bsam grub sgañ-pa* died.

1662

The incarnation of *Rgyal sres*, named *Blo bssañ bstan hdsin*, arrived at *Dgon-luñ*. The abbotship of *Dgon-luñ* was held by *Dpal ldan rgya-mtsho* of *Bde rgyu-chha-va*. Hor *Dkañ behu*, being invested with the title of *Ño-men khan*, returned to *Btsan dgon* from *Dvus* and established *Hchhad ñan*. The period of *Tshul khrim* (*śīla*) commenced.

1664

Ñag dvañ Hphrin las, who was born in the *fire-sheep* year, and who had previously filled the abbotship of *Chhab-mdo*, died this year. *Sprul sku grags rgyan* died.

1666

Blo-bssañ Don yod filled the hierarch's chair at *Dgañ ldan*. *Ta-yan khan* died. The *Sde srid* (viceroy) *Hphrin las* died.

1667

Mchhod dpon sde-ba became *Sde-srid* (viceroy).

1668

Talai khan Ratna became king of Tibet. *Blo-mchhog* of *Sman-luñ* died.

1670

Thu-bkwan chhos-rje (*Blo-bssañ rab brtan*) became abbot of *Dgon-luñ*. *Khri Blo-bssañ rgyal mtshan* died.

1671

Khri-dkon-mchhog chhos bssañ died.

1672

Karma chhos Dvyins rdorje died.

1673

Byams pa Bkra śis filled the hierarch's chair of *Dgañ ldan*. *Likya Dpon slob Blo-bssañ rgyal mtshan* became abbot of *Dgon-luñ*. *Blo-bssañ sbyin-pa* became viceroy of Tibet.

1674

Ñag dvañ Blo-bssañ rgya-mtsho took the vows of the *Stod hdul Dgesloñ* of Tibet for individual emancipation.

1676

Khri Blo-bssañ of *Don yod* died.

1677

The layman *Sañs rgya-mtsho*, who was born in *Groñ-smad*, became viceroy of Tibet.

1678

The abbotship of *Dgon-luñ* was held by Rinpoche *Bstan pañi rgyal mtshan* (*chhu-bssañ sprul sku*). The monastery of *Lamo Bde-chhen* was founded by *Chha-kwan Nomen-khan*.

1679

A long tailed comet was seen from *Mñah ri*. *Shvalu Bsod nam* died.

1680

Klu-kbum rgya-mtsho became hierarch of *Dgañ ldan*. A fearful earthquake took place in Tibet. The *Talai Lama* died.

Dkon-mchhog yar hphel of *Sre-rgyud* died. *Bstan hdsin hphrin las* of *Skyid shod* died.

1681

The Talai Lama Tshañs *dīyans rgya-mtsho* was born. The astronomical work of *Sde-srid*, called *Baidurya dkarpo*, was compiled. 1682

Khri Byams-pa bkra śis died. 1683

After the return of *Blo gros rgya mtsho* to China, *Tshul khrims dar rgyas* of *Chones* became hierarch of *Dgah ldan*. 1684

Lama *Rinpochhe Pad dkar hdsin-pa Yeses rgya-mtsho* was born. The left branch of the *Oeloth Mongols* and the *Khalkhas*, being on the verge of going to war with each other, *Khri Blo-rgya mtsho* reconciled them to each other. 1685

CYCLE XII.

Khri ohhen Blo-bssañ rgya mtsho of *Lamo of Dgah ldan* proceeded to Peking. 1686

Lchañ skya Tákau Sri Nag dvañ Blo bssañ became abbot of *Dgon-luñ*. *Bla-ma Blo-gros rgya-mtsho* died at *Hbog khog*. 1687

Bstan pañi Nima (the *Rdorje slo-dpon* of *Sumpa mkhanpo*), who was an incarnation of *Khri Blo-rgyam*, was born. 1688

Rdo-pa Rab Byams-pa (Dpal ldan rgya-mtsho) became abbot of *Dgon luñ*. 1689

Bsam-blo sbyin-pa rgya-mtsho of *Bkañ hgyur* became hierarch of *Dgah-ldan*. 1691

The *Bde-rgyu chhuñ-va*, named *Kun-dgah rgya-mtsho*, became abbot of *Dgon-luñ*. 1692

The *Sde-srid* (viceroy) *Sans rgya rgya-mtsho* built the nine storeyed palace of worship (*Pho drañ-dmarpo*) of *Potala*. The annual prayer congregation called *Tshogs-mchhod Smon lam* was established by the *Sde-srid* to commemorate the anniversary of the accession of the Talai Lama *Nag dvañ blo bssañ*. 1693

Chone Tshul-dar became hierarch of *Dgah-ldan*. 1694

Blo-bssañ Nag-dvañ Hjigs med, an incarnation of *Rgyal sras Rinpochhe*, was born. 1695

The *Sde-srid* (viceroy) *Sans rgyas rgya-mtsho* wrote the work, called *Boiser shva ser chhos hbyuñ*, i. e., history of the rise of the yellowcap school. 1697

Lama *Rinpochhe Ye-rgyam* of *Mon* arrived at *Hbras-spuañ*. *Chhu bssañ Rinpochhe* became abbot of *Btsan Dgon monastery*. *Btsan po Nomen khan* died. 1698

Hjam dīyañs bahad rdor became abbot of *Sgo-mañ*. 1699

Don-yod rgya-mtsho became hierarch *Dgah ldan*.

Stag-luñ shabs druñ Chhos kyi Nima became abbot of *Dgon-luñ*. 1700

Talai Lama Tshañ *dvyañs rgya-mtsho* renounced the vows of celibacy and monkhood at *Bkra śis lhunpo*. 1701

The *Sde-srid* (viceroy) *Sañs rgyas rgya-mtsho* resigned his office. The Mongol prince *Lha-bssañ* became king of Tibet. { 1702

Sumpa mkhanpo was born. { 1703

Paḍ ḍkar ḥdsin-pa was identified as the real incarnation of the Talai Lama. *Lha-bssañ*, the son of *Rahá rgyal-po*, fought with the *Sde-srid* (viceroy) *Sañs rgyas rgya-mtsho*. The latter was killed, and with him four hundred Tibetans were slain. *Lha-bssañ* declared himself the absolute monarch of Tibet. The Talai Lama Tshañ *dvyañs rgya-mtsho* was ordered to China. He died near lake *Khokonur*. 1704

Paḍ ḍkar ḥdsin-pa *Yeses rgya-mtsho* was placed on the throne of *Potala*. 1706

The Talai Lama *Skal bssañ rgya-mtsho* was born. 1707

A great earthquake took place in Tibet. 1708

The new Talai Lama and *Hjam-dvyañs bshad rdor* were invested with the insignia of an imperial order. *Hjam dvyañs bshad-pa* founded the monastery of *Bkra śis ḥkhyil* in *Amdo*. At *Dgon-luñ* the *Dampa gsúm* (three incarnate Lamas) established the *Rgyud Grva* (Tantrik school). 1709

Chhu-bssañ Rinpo-chhe, a second time, held the abbotship of *Dgon-luñ*. *Sumpa mkhanpo* became a monk of *Dgon-luñ*. 1711

Hjam-dvyañs bshad-pa wrote the work called *Hjig-byed chhos ḥbyuñ*. *Lchañ skya Ṇag dvañ chhos ldan* died. 1713

Hjam dvyañs bshad pa established a Tantrik class at *Bkra śis ḥkhyil*, and wrote a chronology of Buddhist events. 1715

The incarnation of *Lchañskya Yeses bstan-pa Sgron-me* was born.

The armies of *Chuñgar*, or the left branch of the Mongols, slew king *Lha-bssañ*. 1716

The *Chuñgar* armies sacked the *Rñiñ* monasteries of *Rnava rgyal gliñ*, *Edorje brag*, *Smin grol gliñ*, &c., and made the *Dge-lugs-pa* church predominant all over Tibet. 1717

Under the command of the emperor of China the Talai Lama *Bkal-bssañ rgya-mtsho* was brought to Tibet from *Skulbun* by *Thu-bkwan Rinpo-chhe chhos rgya-mtsho* and placed on the throne of *Potala*.

Hbyin rgan became abbot of *Bkra śis ḥkhyil*. *Hjam-dvyañs bshad rdor* died. The emperor *Khañg-shi* died. The third of the Manchu line, called *Shiñ-tsu yuñ-fing*, became emperor. 1721

The Oeloth Mongols of Khokonur fought with the imperial forces and were defeated. The Chinese killed upwards of seven hundred monks of all classes, including the abbot of Gser khog dgon, called Chhu-bssañ rinpoche, and destroyed many religious objects, and burnt down several shrines and congregation halls. They also demolished three great monasteries of Shva-vo khog as well as many hermitages. Many aged monks of Sku-kbum were also killed. Sumpa mkhanpo proceeded to Tibet.

1722

The Chinese, under their generals Kung and Yo-u the-ü, destroyed the temples and grand congregation halls of the Dgon-luñ monastery, and burnt thirteen sets of Bkah-hgyur, and killed many monks. The monasteries of the Hju-lag Sem-ñi-dgon schools, recluses cells, &c., were destroyed by them. In the autumn the three hermitages of Dgon-luñ and Shva-vo khog, and the monasteries of Hju-lag were rebuilt.

1723

Sumpa mkhanpa was appointed abbot of Sgo mañ.

1725

The nineteenth Kulika Rnam-gnon señ (Vikrama Simha) became emperor of Sambhala. When the demon like ministers (Bkah blon) killed the viceroy (Sde-srid) Shañ khañ chhenpo who was a devout advocate of Buddhism, Phola Theje Bsod nams Stobs rgyas (king Mivañ), returned to Dvus from upper Tibet with troops of Ladag, Mñahri, and Gtsañ. He slew upwards of one thousand troops of Dvus and Koñ-po, &c., and entirely suppressed the enemies of the Government.

1726

When the Dvus people rose in rebellion, Phola Theje, being reinforced by the Chinese troops, killed the three rebel ministers and removed the Talai Lama to Hkah-dag. Rgyal sres sprul sku became abbot of Hbras spuñ Blo-gsal gliñ. Phola Theje became viceroy of Tibet, and was also invested with the title of Chun-vañ.

1727

Dgon luñ, Btsan dgon and other monasteries having been restored to their former condition, the author's predecessor Sum-pa chhos rje Phun-tshogs rnam rgyal and Rbu-chhos rje Blo-bssañ dpal became abbots of Dgon luñ and Btsan-dgon respectively.

1728

The author (Sumpa mkhanpo) returned to Amdo from Dvus in Tibet.

1730

The author founded the monastery of Bshad sgrub gliñ.

1732

The author accepted the abbotship of Bsam-gtan gliñ.

1733

Vañ chhos rje-grags-pa dpal hbyor became abbot of Dgon luñ.

At the command of the emperor of China the Lohañskya

Rinpo-chhe brought back the Talai Lama from *Hgah dag* to *Dvus*, and restored peace and prosperity to Tibet and Kham. *Lchañ skya* Rinpo-chhe became famous for his excellent exposition of the work called *Rtan-ñbrel stod-pa*.

1734

Emperor Yung-ting died and was succeeded by his son
• Chhin-lung.

1735

The incarnate Tha-kwan of *Dgon-luñ*, named *Blo-bssañ* chhos kyi Nima, was born. At the command of the emperor the author proceeded to China. *Ñag dvañ nam rgyal*, also called *Khyuñ tsha shabs druñ*, became abbot of *Dgon-luñ*.

1736

A great earthquake took place at the walled city of *Ñiñ-śa mkhan*, near the mountain called *Glañ-ru*, and destroyed the city.

1737

Panchhen *Blo-bssañ yeśes* died.

1738

The sixth incarnate Panchhen *Dpal ldan yeśes* was born. *Bde-rgyu shabs druñ* (*Dge-legs rgyal mtshan*) held the abbotship of *Dgon luñ*.

Rgyal sras ye grags died.

1739

Blo-bssañ dpañ, ldan the incarnation of *Rgyal sras*, was born.

1740

Rgyal tig Rab-khyams-pa (*Blo-bssañ don-grub*) became abbot of *Dgon-luñ*.

1741

A very long comet was observed in Tibet.

1742

The author (*Yeśes Dpal hbyor*), in the forty-third year of his age, was called upon to fill the abbotship of the *Dgon-luñ* monastery.

1745

Inscribed Seal of Kumāra Gupta.—By V. A. SMITH, Esq., C. S.

(With a Plate.)

The first announcement of the discovery of the seal, which forms the subject of this paper, was made by an article entitled "An Archaeological Find" in the *Pioneer* newspaper of the 13th May, 1889. The article attracted my attention, and I published certain remarks on it in the issue of the same newspaper for the 28th May, 1889. A few days later Mr. G. J. Nicholls, C. S., Judge of Cawnpore, entered into correspondence with me, and informed me that he was the owner of the seal. He has very kindly allowed me to examine and describe the original.

The seal (see Plate VI) is oval in shape, slightly pointed at each end, and is $5\frac{1}{2}$ inches long by $4\frac{1}{2}$ wide. The edge varies slightly in thickness, but is generally about $\frac{3}{8}$ ths of an inch thick. The surface is protected by the rim being raised above the face of the plate about $\frac{1}{8}$ th of an inch. The metal is whitish grey, and is thought by Mr. Nicholls to be base silver. The back of the plate is fitted with two solid buttons, each more than half an inch in diameter, by which it could be attached to another object. It probably was attached to an inscription engraved on metal.

The upper section of the face of the seal, being slightly less than one half of the surface, is occupied by a quaint figure of the mythical monster Garuḍa, executed in tolerably high relief. He is represented standing on a base composed of two parallel lines, facing front, with outspread wings. His face is that of a man, broad and full, with thick lips. His hair is arranged exactly like the wig of an English Judge. A snake is twined round his neck, its head projecting above his left shoulder.

A circle, intended doubtless for the discus of Viṣṇu, who rides on Garuḍa, is faintly indicated in the field to the proper right of the figure, and a corresponding dim mark on the proper left is probably intended for the conch shell of the god.

A space an inch in length is left blank at the bottom of the plate. The interval between this space and the parallel lines on which Garuḍa stands is occupied with eight lines of prose inscription. The alphabet is that used by the Gupta kings both for coin legends and inscriptions on stone in Northern India. The letters, though minute, are well and clearly cut in moderately high relief, the vowel marks being fully expressed. Most of the inscription is easily legible, but it is damaged in places, especially in the middle of the second and third lines.

The seal was presented to Mr. Nicholls (who accepted it on behalf of Government) by a member of a very old and respectable Muhammadan family residing at Bhitari near Sayyidpur in the Gházipur District, N. W. P. It was found at some date previous to 1886, when the foundations for a new building were being dug. It is certainly genuine.

The fact that the tablet is a seal is readily proved by comparison of it with similar objects.

The only other known seal of the Early or Imperial Gupta Dynasty is that which is fused on to the spurious copper plate grant from Gayá, purporting to have been made by Samudragupta. That seal is of copper, and is described as follows by Mr. Fleet:—"On to the proper right side of the plate, there is fused a seal, oval in shape, about $2\frac{1}{4}$ " by $3\frac{3}{4}$ ". It has, in relief on a countersunk surface—at the top, Garuḍa, represented

as a bird, standing to the front, with outstretched wings; and, below this, a legend in five lines, which, being also in relief, is so worn that nothing of it can be read except a few disconnected letters here and there, and *Sam[u]drag[u]p[taḥ]*, very faintly, at the end of line 5. It must have contained a succinct recital of the genealogy, after the fashion of the *Asīrgaḍh* seal of *Śarvavarman*, No. 47 above, page 219, and the *Sonpat* seal of *Harshavardhana*, No. 52 above, page 231 The legend on the seal of this grant is in characters which present a very different appearance to those of the body of the inscription; as also does the copper of the seal, as compared with the substance of the plate; and the seal is in all probability a genuine one of *Samudragupta*, detached from some other plate.”*

The copper seal of *Harshavardhana*, above referred to, is even larger than the one now under examination, measuring $5\frac{1}{8}$ " by $6\frac{1}{8}$ ". It weighs three pounds six ounces. "All round it there runs a rim, about $\frac{1}{4}$ " broad; and inside this there are, in rather shallow relief on a slightly countersunk surface,—at the top, a bull, recumbent to the proper right; and below this the inscription,"† in thirteen lines.

The *Garuḍa* device recurs on the seal of the copper plate inscription of *Rāja Tivara Deva* (circa A. D. 800), found at *Rājim* in the Central Provinces. "The top of the seal is circular, about $3\frac{3}{8}$ " in diameter. It has, in relief on a rather deep countersunk surface, across the centre, a legend, in two lines; in the upper part a figure of *Garuḍa*, facing full front, depicted with the head of a man, and the body of a bird, with his wings expanded, with, apparently, human arms hanging down between the wings and the feet, and with a serpent with expanded hood, standing up in front of and over each shoulder; on the proper right of this, a *chakra* or discus, the emblem of *Vishṇu*; and on the proper left a *śaṅkha* or conch shell; in the lower part, a floral device."‡

The device on the upper portion of a royal seal was invariably the emblem used by the dynasty concerned as its special cognizance. The seal under discussion and the *Gayā* one of *Samudra Gupta* settle definitely that the image of *Garuḍa* was the family cognizance of the Early Guptas, and so explain the phrase *Garumad-anka* in the posthumous inscription of *Samudra Gupta* at *Allahabad*, the bird-headed standard of the *Gupta* gold coins, and the reverse device of the copper coins. No doubt can now be felt that in all these cases the mythological significance of the bird-like figure is the monster *Garuḍa*, the vehicle of *Vishṇu*. The

* Fleet, *Corpus Inscriptionum Indicarum*, Vol. III, p. 255.

† Fleet, *ibid.*, Vol. III, p. 231.

‡ Fleet, *ibid.*, Vol. III, p. 292.

form of the Garuḍa-headed standard on the gold coins was, I am confident, borrowed from the Roman eagle, and the form of the device of the copper coins may have been imitated from a Greek original, that is to say, from the owl of Athene, especially as represented on coins of Pergamon.*

Sometimes Garuḍa is represented with human arms, as on the Rājim seal, and sometimes without them, as on the seal of Kumāragupta. The same variation of detail is observable in the case of the copper coins.†

The inscription on Kumāragupta's seals, is, as usual with seal legends, purely genealogical; and the greater part of the record gives the particulars of the Gupta genealogy in the standard form of words employed in the Bhitari pillar inscription and other Gupta inscriptions.‡

In the beginning the seal omits, between the words *apratirathasya* and *mahārāja-s'rī-Gupta*, a string of epithets given in the pillar inscription, but, from the words *mahārāja-s'rī-Gupta* down to the name of Kumāragupta in the fifth line, the record is identical (except by omitting Kumāra's title of *paramabhāgavato*), word for word, with that incised on the Bhitari pillar. The rest of the newly discovered inscription does not seem to be quite identical with the wording of any known record. A son of Kumāragupta is certainly mentioned, and the name of Kumāra's queen, Anattadevi (?), is stated, but I am doubtful whether the name Skanda occurs or not. I can read only partially the 6th and 7th lines. The first four characters of the concluding 8th line are indistinct, but the remainder is easily legible, and shows that the seal belongs to the reign of Kumāragupta, *circa* A. D. 414--452.§

The antiquities at Bhitari, near Sayyidpur at the eastern extremity of the Ghāzipur District in the North-Western Provinces, about half way between Benares and Ghāzipur, have long been known to archæologists. The site was carefully explored more than fifty years ago by Sir Alexander Cunningham and his friend Mr. Vincent Tregear. The latter became the possessor of a valuable collection of coins, many of which are now in the Bodleian cabinet.

The most notable relic is the monolith pillar bearing an inscription of the reign of Skandagupta. A translation of this record, made from Sir A. Cunningham's copy, was published by Dr. Mill in the Journal of this Society in 1837. Certain minor corrections in this translation were

* Smith, *Coinage of the Early Gupta Dynasty* in the Journal of the Royal Asiatic Society, for Jan. 1889, p. 24; see also Fleet, *ibid.*, Vol. III, p. 14, note 3.

† Smith, *ibid.*, Plate IV, figures 8—15.

‡ Fleet, *ibid.*, Vol. III, p. 53, etc.

§ Smith, *ibid.*, p. 6.

*Translation.**

(Lines 1 and 2.)—The son of, the Mahārājādhirāja, the glorious **Samudra-Gupta**, who was the exterminator of all kings; who had no antagonist (*of equal power*) in the world; who was the son of the son's son of the Mahārāja the illustrious **Gupta**; who was the son's son of the Mahārāja, the illustrious **Ghoṭotkacha**; (*and*) who was the son of the Mahārājādhirāja, the glorious **Chandragupta** (I.), (*and*) the daughter's son of Lichchhavi, begotten on the Mahādevī KUMĀRADEVĪ,

(Line 3.)—(*was*) the most devout worshipper of the Divine One, the Mahārājādhirāja, the glorious **Chandragupta** (II.), who was accepted by him (*i. e.*, *Samudragupta*); who was begotten on the Mahādevī DATTADEVĪ; and who was himself without an antagonist (*of equal power*).†

(Line 4.)—His son (*was*) the Mahārājādhirāja, the glorious **Kumāragupta** (I.), who meditated on his feet, (*and*) who was begotten on the Mahādevī DHRUVADEVĪ.

(Line 5.)—His son (*was*) the Mahārājādhirāja, the glorious **Puragupta**, who meditated on his feet, (*and*) who was begotten on the Mahādevī ANANTADEVĪ.

(Line 6.)—His son (*was*) the Mahārājādhirāja, the glorious **Narasimhagupta**, who meditated on his feet,* (*and*) who was begotten on the Mahādevī ŚRĪVATSADEVĪ.

(Lines 7 and 8.)—His son (*was*) the most devout worshipper of the Divine One, the Mahārājādhirāja, the glorious **Kumāragupta** (II.), who meditated on his feet, (*and*) who was begotten on the Mahādevī ŚRĪMATĪDEVĪ.

All the names of the kings are quite legible on the original seal: quite sufficiently so, to identify them satisfactorily.‡ Of the names of the two last queens, *Śrīvatsa* and *Śrīmatī*, the two first syllables respectively (*Śrīva* and *Śrīma*) are legible; but the terminal ones (*tsa* and *tī*) can only be faintly seen.

Before discussing the information of this record, some of its techni-

* I follow Mr. Fleet's translation (*Corpus Inscriptionum Indicarum*, Vol. III, p. 54) as far as it goes.

† Or, "who was himself an antagonist (*of equal power to all his enemies*)," if we read *svayam cha pratirathaḥ*; see below.

‡ The photographic plate unfortunately is not quite as distinct, as one would wish. The original plate requires to be held in various lights, and to be examined with a large magnifying glass; but with these helps there is really not much difficulty in reading the whole of the record, with the exception of those small and unimportant portions (in straight brackets) that are entirely rubbed away (apparently during the process of cleaning the plate.)

calities may be briefly noted. Firstly, the uniform use of the *upadhāniya*, in l. 1, *rājochchhettuḥ prithivyām*; l. 3, *apratirathaḥ parama°*; l. 8, *utpannaḥ parama°*, and secondly, of the doubling of *t* and *dh* when followed by *r* and *y* respectively, as in l. 1, *prapauttrasya* and *pauttrasya*; l. 2, *puttrasya* and *dauhitrasya*; l. 3, 4, 5, 6, 7, *puttras*; l. 4, 5, 6, 7, *páddnuddhyāto*; thirdly, the assimilation of the visarga to a following *s*, in l. 3, *utpannas-svayaṃ*; fourthly, the reading *svayaṃ ch'ápratirathaḥ* in l. 3. The same phrase is read by Mr. Fleet* in the Bhitari stone inscription (l. 4) *svayaṃ apratirathasya*. The phrase also occurs in Kumāragupta I.'s Bilsaḍ stone inscription and in Skandagupta's Bihār stone inscription* but in the former it is illegible, and in the latter it is cut away and lost. There are, therefore, only two records (the seal and the stone of Bhitari) to establish the reading; and the exact point is whether the *akshara* that follows *svaya* should be read *ma* or *cha*. Now in the Bhitari stone inscription (at least, as shown in Mr. Fleet's plate) the *akshara* is too indistinct to be definitely identified; while on the Bhitari seal it is quite distinctly *cha*. Moreover the seal has a distinct *anuswāra* over the *ya* of *svaya*, which *anuswāra* is apparently also present on the Bhitari stone; and the *anuswāra* only agrees with the reading *cha* or rather *chá*. The vowel mark over *cha* is hardly distinguishable in the present state of the seal; and the reading *cha pratirathaḥ* would also give sense, but a sense not quite so suitable to the context (see the translation, above). It is preferable, therefore, to read *svayaṃ ch'ápratirathaḥ*.

The record gives the names of nine kings, viz., 1, Gupta, 2, Ghaṭotkacha, 3, Chandragupta I., 4, Samudragupta, 5, Chandragupta II., 6, Kumāragupta I., 7, Puragupta, 8, Narasimhagupta, and 9, Kumāragupta II.; and it states distinctly that each of these kings stood in the relation of son to the preceding one. It further gives the names of six queens, viz., 1, Kumāradevī, the wife of Chandragupta I. and mother of Samudragupta; 2, Dattadevī, the wife of Samudragupta and mother of Chandragupta II.; 3, Dhruvadevī, the wife of Chandragupta II. and mother of Kumāragupta I.; 4, Anantadevī, the wife of Kumāragupta I. and mother of Puragupta; 5, Śrīvatsadevī, the wife of Puragupta and mother of Narasimhagupta; and 6, Śrīmatidevī, the wife of Narasimhagupta and mother of Kumāragupta II.

The two longest genealogies of the Early Guptas, hitherto known, are those on two stone pillar inscriptions, both of Skandagupta,† one at Bhitari, the other at Bihār. That at Bihār is greatly mutilated and

* *Corpus Inscriptionum Indicarum*, Vol. III, p. 53; also pp. 48, 50.

† They are given by Fleet in *Corpus Inscriptionum Indicarum*, Vol. III, pp. 47 and 52.

of subordinate value. They mention only the following seven kings: 1, Gupta, 2, Ghaṭotkacha, 3, Chandragupta I., 4, Samudragupta, 5, Chandragupta II., 6, Kumāragupta, 7, Skandagupta. Here again each king is expressly stated to have been the son of his predecessor. They further name the following three queens: 1, Kumāradēvī, wife of Chandragupta I. and mother of Samudragupta; 2, Dattadēvī, wife of Samudragupta and mother of Chandragupta II.; 3, Dhruvadēvī, wife of Chandragupta II. and mother of Kumāragupta I.

In the main these two records agree with that of the seal; and this proves that the seal is that of a member of the great Early (or Imperial) Gupta family. This is shown also by the use of the imperial title *Mahārājādhirāja*. But there are two important differences. The first is that the seal calls the seventh member of the line Puragupta, while the other two records call him Skandagupta. The second is that the seal carries the line down to the ninth generation, to another Kumāragupta, and traces it through Puragupta, instead of through Skandagupta. This proves two things: 1, that the Early Gupta dynasty did not terminate, as it has been hitherto believed, with Skandagupta, but that it lasted for, at least, two generations longer (*i. e.*, down to about 550 A. D.); and secondly that there was a second Kumāragupta among the Early Guptas. The latter discovery may possibly necessitate a reconsideration of all those chronological and other speculations which were based on the (hitherto uncontradicted) belief, that there was but *one* Kumāragupta in the dynasty.

The chief difficulty is that with respect to the relation of Puragupta to Skandagupta. Are they but different names of the same person, or was one the (younger) brother of the other?

One point may be noted with regard to these two kings. The inscription on the seal states that Puragupta's mother, and, therefore, Kumāragupta I.'s queen, was named Anantadēvī. The two stone inscriptions do not name Skandagupta's mother or Kumāragupta's queen, though they speak of her. In the Bhitari inscription it is related, how Skanda restored the imperial power of the Guptas, which appears to have suffered a serious reverse during his father Kumāragupta's time; and how he afterwards visited his mother to report to her his victories; but the mother is not named. In the Bihār inscription, it is stated that Kumāragupta married the sister of some person, whose name, however, as well as that of his sister are unfortunately lost in the mutilated record. But from a subsequent equally fragmentary portion of the record (see l. 13 in Fleet's transcript) it would seem that the brother's name may have been *Anantasena*. In that case, his sister would probably have been named *Anantadēvī*; and this would agree with the record on the seal. In that case, further, Skandagupta and Puragupta would have had not only the same

father Kumāragupta, but also the same mother Anantadevi. It may be further noted, that while the seal names Śrīvatsadevi as the queen of Puragupta, the queen of Skandagupta is nowhere either named or even mentioned. So far as his records are concerned, he might not have been married at all.

The question still remains, are Skandagupta and Puragupta the same persons, or are they brothers? It seems hardly probable that in such genealogies the same person would be called by different names. The probability, as I shall show further on, would seem to be, that Puragupta is a (younger) brother of Skandagupta, and succeeded the latter, who died without issue. There would still be a difficulty in the fact, that Skandagupta is entirely omitted from the list on the seal. But such omissions are not without precedent in lists which are rather intended to record the line of descent than the line of succession.* The term *pādānudhyāta*, however, no doubt, properly indicates Puragupta as having been the immediate successor of his father rather than a remoter successor of him after his brother Skandagupta.

The discovery of this seal solves another mystery. Among the gold coinage of the Early Guptas, certain coins have been found, bearing the name of Nara (or Naragupta) and the title *Bālāditya*.† That they belong to the proper Gupta class of coins, has never been seriously doubted; their resemblance to them is too thorough. But the difficulty was, where to place them; as no member of the Gupta family, called Nara, was known to have existed. It can hardly be doubtful now, to whom these Nara-coins belong. They are clearly issues of the Nara-simhagupta of the new seal.

This, however, suggests a further consequence. Mr. Smith, in his *Coinage of the Early Gupta Dynasty*, has shown (pp. 40) that certain specimens of the Gupta coinage show an exceptionally heavy weight. Some of these coins belong to Nara (simhagupta); others to a king of an unknown name who has the title of *Prakāśāditya*; others again to a certain Kumāragupta. The obverse of the *Prakāśāditya* coins would (as usual) give the proper name of the king; but unfortunately in all the specimens hitherto found the name is lost. It may now be suggested

* A very curious, though not quite analogous, case of a similar omission occurs in one of the Valabhi grants (No. IX, in *Indian Antiquary*, Vol. VII, p. 66), where Guhasena's father Dharapaṭṭa is omitted, and he is placed immediately after his uncle Dhruvasena I. It is not impossible, that Dharapaṭṭa never reigned; if so, the record is one of the line of succession rather than of the line of descent.

† Mr. Smith denies the occurrence of *Gupta*; see his *Coinage of the Early Gupta Dynasty*, p. 118. But see fig. 22, on Pl. XVIII of the *Ariana Antiqua*. The fact, however, whether the coins do or do not bear the word *Gupta*, does not affect the argument.

that these coins perhaps belong to Puragupta. The heavy coins of Kumāragupta, with the special title of *Kramāditya*, should probably now be ascribed to Kumāragupta II., the last of the list on the seal, and not to the Kumāragupta who is numbered the fourth in the list of the Later Gupta dynasty of Magadha.*

It is impossible to identify the Kumāragupta II. of the Bhitari seal with the Kumāragupta of the Later Guptas, although their periods probably coincide. For all the other names do not agree. The later Kumāragupta was the fourth of his line and was preceded by three princes, *viz.*, Krishnagupta, Harshagupta, and Jivitagupta I., standing in the relation of father to son. It would, then, be necessary to assume that Jivitagupta I., Harshagupta and Krishnagupta were identical respectively with Narasimhagupta, Puragupta and Kumāragupta I., which is clearly inadmissible. Or supposing Krishnagupta to have immediately followed Skandagupta of the early dynasty, and even assuming Puragupta and Narasimhagupta to be identical with Krishnagupta and Harshagupta, there would Jivitagupta still remain to be accounted for, and the Kumāragupta II. of the seal would fall one generation earlier than the Kumāragupta of the later dynasty. Further, the Kumāragupta II. of the seal bears the well-known imperial titles equally with his predecessors of the early dynasty; while the Kumāragupta of the later dynasty, as shown in the Apsad stone inscription,† *lays*, equally with his predecessors, no claim even to the subordinate title of Mahārāja. They designate themselves merely *nripa* or *bhūpati*. It was only the fourth of Kumāra's successors, Ādityasena (preceded by Dāmodaragupta, Mahāsenagupta and Mādhavagupta), who was the first to lay again claim to the imperial title of Mahārājādhirāja.‡ The seal, thus, decides a hitherto open question and proves that the Later Guptas of Magadha were not direct descendants of the Early Guptas. For the first three members of the Later Gupta line, Krishna, Harsha and Jivita I., must practically have been contemporaries of the three last members of the Early Gupta line, Pura, Narasimha and Kumāra II. And as Narasimha Bālāditya is also called a king of Magadha (*e. g.*, by Hiuen Tsiang, see below), it is clear that Krishna and his immediate successors can only have been small princes or chiefs in Magadha, by the side of their imperial relatives. Similar remarks apply to the Later Guptas of Eastern Málava, Budhagupta and Bhānugupta.

There are two other references to Narasimhagupta, under his title of Bālāditya, in two inscriptions of much later times. The first is the

* See the list in Fleet's volume III. of the *Corpus Inscr. Ind.*, p. 205.

† See *ibid.*, pp. 202, 203.

‡ See *ibid.*, p. 212.

Deo-Baranārk inscription of Jīvitagupta II. of the Later Gupta dynasty. In this inscription Narasimhagupta is referred to as an emperor (*paramēśvara*) who ruled long previously. The distance in time between Jīvitagupta II. and Narasimhagupta would be about 200 years. The second is the Sárnāth inscription of a certain king, Prakāśāditya of Benares, of the end of the seventh century A. D. Here Narasimhagupta is referred to as one of Prakāśāditya's early ancestors, and as the ruler of *Madhyadeśa* or the central portion of Northern India. This description would not be unsuitable to the ancestral portion of the dominions of the Early Guptas.

The historic truth of the new seal is also proved by the inscriptions on the copper-plate grants of the so-called Parivrājaka Mahārājas, which were all issued during "the enjoyment of sovereignty by the Gupta kings." The seal shows that the line of the Early Guptas was continued down to Kumāragupta II. The latter must be placed about A. D. 530-550, and the latest of the Parivrājaka grants is dated in A. D. 528. The earliest is dated in A. D. 475; therefore already in the reign of Puragupta (see below). They all fall within the period of the great decadence of the Gupta power; and this fact may possibly account for the circumstance, that in those grants the Guptas are simply designated by the vague term *nripa* 'king.' At the same time, Mr. Fleet's observation,* that "they show that the Gupta dominion still continued, and the name of the Gupta kings was still recognised as a power, down to A. D. 528," is fully borne out by the new seal.

I add to these remarks, for ready reference, a synchronistic Table of the probable reigns of the Early Guptas and their contemporaries or immediate successors. The numbers within angular brackets give the known dates, derived from inscriptions and other sources. Various observations suggest themselves by this table.

For an approximate determination of the period of Puragupta and Narasimhagupta we have the following data. Hiuen Tsiang relates, how Mihirakula was defeated and taken prisoner by king Bālāditya of Magadha.† This reference,—there can hardly be a doubt—is to Mihirakula's final overthrow in India; for, on being released by Bālāditya, he is said to have retired to Kashmīr. The credit of this great overthrow, however, is ascribed to a king Yaśodharman in one of the latter's Mandasor stone pillar inscriptions.‡ In it it is stated that, at some time previous to the setting up of the pillar, Yaśodharman had subdued and extended his dominion over countries which even the Guptas and Hūnas

* See *Corpus Inscr. Ind.*, Vol. III, p. 8.

† See Beal's *Buddhist Records of the Western World*, Vol. I, pp. 168-170.

‡ No. 33, in Fleet's *Corp. Inscr. Ind.*, Vol. III, p. 142.

had not possessed. This inscription is not dated, but its date cannot have been very different from that of another Mandasor stone inscription of Yaśodharman,* dated in A. D. 533-534, because they were both engraved by the same person Govinda. In this inscription, it is stated that Yaśodharman, who was originally only a tribal chieftain (*jinendra* or *narādhipati*), succeeded in conquering the countries around him and thus founding an empire, after which he took the name of Vishṇuvardhana and the imperial titles of *rājādhirāja* and *paramēśvara*. Of these two inscriptions, the latter would seem to be—if anything—the later in date. In any case Mihirakula's overthrow would fall some time previously to A. D. 533; and it may be set down in A. D. 530, or perhaps even a little earlier.† It follows, that Báláditya, in whose reign Mihirakula's overthrow took place, must have reigned down to about A. D. 530. The circumstance, that the overthrow is ascribed to both Báláditya and Yaśodharman, would seem to be best explained thus, that Báláditya was, at least nominally, the paramount ruler or Emperor (*Māhārājādhirāja*), and that Yaśodharman, at that time a mere 'tribal chieftain,' was one of his feudatories or lieutenants, who actually accomplished the defeat of Mihirakula, but thereupon took advantage of his great success to found an empire for himself. In fact, it was probably Yaśodharman (rather than the Hūnas) that supplanted Kumāragupta II., some time after 530 A. D., thus finally breaking up the Early Gupta empire, and building up his own empire on its ruins.

On the other hand Skandagupta's earliest recorded date is A. D. 455. From this date down to A. D. 530 there are 75 years; and for this interval we have three names Skandagupta, Puragupta and Narasimhagupta. The interval can be more easily filled up by two generations including three reigns, than by two generations including only two reigns; i. e., by assuming that Skandagupta and Puragupta were brothers, succeeding one another and being themselves succeeded by Narasimhagupta. Skandagupta is known to have been still reigning in A. D. 466 or 468. He may have been succeeded by his (younger) brother Puragupta c. A. D. 470, and the latter, c. A. D. 485, by his son Narasimhagupta. This would give to Narasimhagupta the long reign of about 45

* No. 35, *ibid.*, Vol. III, p. 150.

† In these calculations I follow, in the main, Mr. Fleet's remarks, in *Corp. Inscr. Ind.*, Vol. III, pp. 10-12 (Introd.), 146, 152. But I do not agree with his view about Vishṇuvardhana, *ibid.*, p. 151. (See Proceedings for August, 1889.) It seems to me better to accept the words, in l. 5 of the inscription, in their obvious sense that Yaśodharman is identical with Vishṇuvardhana, and to suppose that Yaśodharman assumed the title Vishṇuvardhana after (and perhaps in commemoration) of his great victory. It is most improbable that the imperial titles of *rājādhirāja* and *paramēśvara* should be ascribed to a mere feudatory.

years, if he was still reigning in A. D. 530. There is, however, nothing at all improbable in this supposition.

Further, Narasimhagupta calls himself Báláditya on his coins. We have seen that the Báláditya of Hinen Tsiang's account reigned down to c. 530 A. D.; and that it is quite possible that the Narasimhagupta of the seal reigned down to that date. It may, therefore, be concluded as most probable that the Narasimhagupta of the seal is identical with the Nara Báláditya of the coins as well as the Báláditya of Magadha, by whom, or rather in whose reign Mihirakula was overthrown by Yaśodharman.

A curious glimpse of Narasimhagupta is afforded in a passing allusion, in connection with the Valabhí king Droṇasimha, to his suzerain power, the Early Guptas. The early Valabhí rulers, as is well known, were vassals of the Early Guptas. The third of the Valabhí line was Droṇasimha, a younger son of the founder of that line, Bhaṭārka Senápati. Regarding this Droṇasimha it is mentioned in the Valabhí genealogies that he "was anointed in the kingship by the paramount master (*parama-svamin*) in person" Mr. Fleet* has suggested that this "paramount master" was Yaśodharman, who defeated Mihirakula c. 530 A. D. Now Dhruvasena I. was reigning in 526, as shown by his inscription. Droṇasimha was his predecessor; and his accession must, therefore, be placed c. 520 A. D. It is not probable that Yaśodharman was already in 520 A. D. an 'emperor' whose sway extended over the Valabhís. In fact, as I have tried to show, it is more probable, that in A. D. 530 he was still a mere 'tribal chieftain' and lieutenant of the emperor Narasimhagupta, and that his great power only dated from that victory over Mihirakula. On the other hand, about A. D. 520, Narasimhagupta must have still enjoyed the imperial dignity of the Guptas; and however much it may have been shorn of its ancient splendour, it was clearly still so much recognised by the Valabhís, that Droṇasimha got himself "anointed" by the still existing representative of that power. It may be added that the simple reference to the *parama-svamin* or "paramount master" is more easily explainable if applied to the old accustomed suzerain power of the Guptas, than to a new emperor like Yaśodharman.

That notice about Droṇasimha's "being anointed by his paramount master" is a rather curious one. His two predecessors enjoyed only the title of *senápati*; he was the first of his house who bore the title of *mahárāja* (equal to *mahásenápati*). The notice about his 'anointment' would seem to refer to his elevation to the higher rank of a Mahárāja.

* See *Indian Antiquary*, Vol. XV, p. 187, note; also *Corpus Inscr. Ind.*, Vol. III, p. 168.

The special occasion or reason for this elevation by the paramount power we are not told. But putting together the scattered historical indications of that period, it would seem that the distinction was due to a striking recovery in the fortunes of the Imperial Gupta dynasty which was mainly brought about by the exertions of the Valabhī feudatories. The circumstances are these. There are three inscriptions at Eran in Eastern Málava,* referring themselves respectively to the times of Budhagupta, Toramāṇa and Bhānugupta. Budhagupta and Bhānugupta were mere second rate rulers of Eastern Málava; but Toramāṇa possessed Eastern Málava as a portion of his imperial dominions; and his inscription is dated in the first year of his imperial power.† It may be concluded, that in that year neither Budhagupta nor Bhānugupta possessed Eastern Málava. The dates of the inscriptions of these two Mahārājas are 484 A. D. and 510 A. D. The first year of Toramāṇa cannot well fall after 510 A. D.; for it can be shown‡ that Toramāṇa was already succeeded by his son Mihirakula c. A. D. 515, and possibly even a little earlier. Again it cannot fall before 484 A. D., because in that year there were living two princes Mātṛivishṇu and his younger brother Dhanyavishṇu, the former of whom was dead in the first year of Toramāṇa. Nor can it fall before 494 A. D., because that is the last recorded date (on his coins) of Budhagupta. It follows that not only the first year of Toramāṇa's imperial power, but also his loss of that power (so far, at least, as Eastern Málava was concerned) must fall within the period A. D. 494-510. Now this is just about the period of the Senāpati Bhaṭārka, the first of the Valabhī dynasty, who must have ruled from c. 495-515 A. D. With regard to him it is expressly stated, in the Valabhī genealogical records,§ that he fought with and defeated the "Maitrakas," that is, the Mihiras (a tribal designation of the Hūnas) to whom Toramāṇa belonged. It may be concluded, therefore, that it was mainly owing to the Valabhī victories that Toramāṇa was beaten back and lost his imperial power. The immediate consequence of this success of the Valabhīs would naturally have been the revival of the imperial power of the Guptas, that is, of Narasimhagupta who was on the throne of the Guptas at that time. The first year of Toramāṇa, say A. D. 495, would be the date of

* See Fleet, *Corp. Inscr. Ind.*, Vol. III, pp. 88, 91, 158.

† See Fleet, *ibid.*, Vol. III, p. 158. The first year, named in the inscription, is not the first year of Toramāṇa's accession to rule over the Hūna tribe, but of his assumption of the imperial dignity (*mahārājādhirāja*) after his Indian conquests. See Fleet, *ibid.*, *Introd.*, pp. 10-12.

‡ See Fleet, *ibid.*, Vol. III, *Introd.*, p. 12; also *Indian Antiquary*, Vol. XV, p. 252.

§ See Fleet, *ibid.*, Vol. III, p. 167.

the temporary subjection of the emperor Narasiṃhagupta, and of the assumption of the imperial dignity, by Toramāṇa; and A. D. 510 may be taken as approximately the date of the liberation, by the Valabhī senāpati Bhaṭārka, of Narasiṃhagupta and the resumption by the latter of the imperial crown. And I would suggest, that the subsequent elevation, by Narasiṃhagupta, of the Valabhī Droṇasiṃha, c. A. D. 520, to the rank of Mahārāja, was in some way an acknowledgment of the signal service rendered by the Valabhī family to the imperial house of the Guptas. Toramāṇa must have died soon after the great reverse he suffered at the hands of the Valabhīs. He was succeeded, c. A. D. 515, by his son Mihirakula, who undertook to recover his father's conquests, or, as Hiuen Tsiang puts it in his account, "to punish the rebellion" of Narasiṃhagupta. For fifteen years, as shown by the Gwalior inscription,* he was successful in his operations, till at last, c. A. D. 530, he was totally defeated by the emperor Narasiṃhagupta's great vassal Yaśodharman. According to Hiuen Tsiang, Mihirakula was taken prisoner in the battle and brought to Narasiṃhagupta. On the advice of the latter's mother, he was restored to liberty, but finding his chances in India utterly gone, he retired to Kashmīr. This seems to me to have been the course of events in that troubled period of the irruption of the Hūnas into India.†

I should like to throw out another suggestion. In the list of kings of the Rājataranginī, there are five reigns enumerated between Matrīgupta and Durlabha I., if we omit the fabulous king Raṇāditya with his reign of 300 years. Durlabha I.'s accession may be placed in 626 A. D., allowing a probable adjustment of 30 years in the calculations of the Rājataranginī.‡ Calculating a reign at the usual average of about 18 years, we obtain for the accession of Matrīgupta about the year 530 A. D., i. e., the probable year of Mihirakula's retirement into Kashmīr. I would suggest the identity of Matrīgupta and Mihirakula. There are many points in favour of the suggestion: 1, the epochs of the two kings coincide; 2, the name Matrīgupta means "protected by the mother," and according to Hiuen Tsiang, Mihirakula owed his life to the intercession and protection of (Narasiṃhagupta) Bālāditya's mother; the name, therefore, would fit him admirably; 3, Matrīgupta is said to have

* See Fleet, *Corpus Inscr. Ind.*, Vol. III, p. 161.

† It may be worth noting in connection with the irruption of the Huns into India in the 5th century, that it followed, by nearly a century, their irruption into Europe. The latter is said to have begun in 375 A. D., under their leader Balamir, and it was most successful under their leader Attila, A. D. 445-453. Their power was finally broken in the great battle on the Catalaunian fields, A. D. 451; corresponding to the great victory of Yaśodharman (or Yaśovarman) in A. D. 530.

‡ See Sir A. Cunningham, *Ancient Geography of India*, p. 92; also Jacobi in *Göttingische Gelehrte Anzeigen* for 1888, No. 2, p. 70.

been a stranger to Kashmīr; so was Mihirakula; he is said to have been imposed on Kashmīr by a king Vikramāditya, also called Harsha, of Ujjain, who is said to have been a powerful king who subdued the whole world and destroyed the Śakas, a Mlechchha tribe. This I take to be a confused version of the fact, that during the time of Narasiṃha-gupta Bālāditya, who afterwards allowed Mihirakula to proceed to Kashmīr, the Hūṇa (a Śaka tribe) were defeated by Yaśovarman, who afterwards made himself an "emperor." Vikramāditya was a common title in the Gupta family; Chandragupta II. and Skandagupta bore it; and the similar title Kramāditya was born by Skandagupta and Kumāragupta II. In the Rājataranginī either Bālāditya or Kumāragupta II. Kramāditya is referred to by Vikramāditya; and this Vikramāditya is said to have died before Mātṛigupta's resignation of his kingdom. As Mātṛigupta is said to have resigned after a reign of about four years, and as on the assumption of his identity with Mihirakula, he became king of Kashmīr about A. D. 530, Bālāditya must have died very soon after that year. According to the Rājataranginī, Vikramāditya had a son, Pratāpāsīla Śīlāditya, who was expelled by the people of Mālava, but reinstated by king Pravarasena of Kashmīr. Here, again, there is a confused version of certain facts. I take this Śīlāditya to be identical with the king Śīlāditya of Mālava, who, according to Hiuen Tsiang, had lived 60 years before his own time, and who had reigned for 50 years.* As Hiuen Tsiang was in Mālava in A. D. 640, the period of Śīlāditya's reign is fixed as from about A. D. 530-580. He is commonly identified with the unnamed 'monarch' who is, by Hiuen Tsiang, said to have succeeded Vikramāditya of Śrāvastī; and this Vikramāditya himself is commonly identified with the Vikramāditya of Mālava, above mentioned.† According to Hiuen Tsiang, Vikramāditya "lost his kingdom" and was succeeded by the unnamed "monarch", i. e., by Śīlāditya. I would suggest that Kumāragupta II. Kramāditya is intended by Vikramāditya, who lost his kingdom by the usurpation of Yaśodharman; and that Śīlāditya is one of the surnames of Yaśodharman. The latter, in his inscription (see above) is called, at first, only a *narāṭhipati*, which would agree with the "monarch" of Hiuen Tsiang. The times also agree; Yaśodharman Śīlāditya must have usurped the imperial dignity soon after A. D. 530. He would then have reigned about 50 years, down to about A. D. 580. Throughout the whole of his reign (compare columns 5 and 8 of the synchronistic table), he had rivals for his claim of the imperial dignity in the Maukharī Varmans, till the dignity was finally secured by Prabhākara Vardhana who had

* See Beal's *Buddhist Records of the Western World*, Vol. III, p. 261.

† See *ibidem*, Vol. I, pp. 106, 108.

the surname of Pratāpaśīla. According to Hiuen Tsiang the Valabhī king Dhruvasena II. (or Dhruvapaṭa),* who became king about A. D. 625, was his nephew (*i. e.*, probably sister's son). All this agrees well enough. That Vikramāditya (*i. e.*, Kumāragupta II.) is described as "king of Śrāvastī" need be no difficulty. Kumāragupta's seal was found at Bhitari, in the Ghāzīpur District of the N.-W. Provinces; and Śrāvastī may well have been the favourite residence of that emperor. Of course, if my suggestions are accepted, the narrative in the Rājataranginī is a confused, and even grotesque, perversion of the real facts. Śīlāditya is said to have been a son of Vikramāditya; this is a confused reminiscence of the fact, that Bālāditya (*i. e.*, Narasimhagupta) had a son Kumāragupta II. Kramāditya;—Śīlāditya is said to have been expelled by the people of Mālava; but it was Kumāragupta that was "expelled," *i. e.*, rebelled against by Yaśodharman (Śīlāditya);—Śīlāditya is called Pratāpaśīla; but the latter was the surname of Śīlāditya's rival, Prabhākara Vardhana;—Śīlāditya Pratāpaśīla is said to have been seven times subdued by the king of Kashmīr; very possibly the king of Kashmīr had to carry on several campaigns against both Śīlāditya (Yaśodharman) and Pratāpaśīla (Prabhākara Vardhana), both of whom aspired to be "emperors" or "rulers of the whole world." The Rājataranginī's account of Mātrigupta is still more grotesque. It makes Mātrigupta to be a poor "poet,"† and finally resign his kingdom and retire to Benares, like a good Hindū! But it hardly needs an excuse for charging the "history" of the Rājataranginī with grotesqueness. The utter untrustworthiness of it down to the time of the Karkoṭa dynasty (Durlabha Vardhana I.), is, I believe, now generally acknowledged. Its treatment of Mihirakula, who under that name is placed at B. C. 707,‡ and of Toramāṇa and Hiranyakula, is the most glaring evidence of it.

I add a sketch of what seems to me to have been the fortunes of the imperial dignity during the periods immediately before and after the Hūṇa troubles. I have shown them in the synchronistic table by printing in red the names of those princes that bore the imperial title of Mahārājādhirāja. From Chandragupta I. down to Kumāragupta II., c. A. D. 360-533, the imperial dignity remained with the house of the Early Guptas. Under Narasimhagupta, c. A. D. 495, it was disputed by the Hūṇa chief Toramāṇa. About 533 A. D., under Kumāragupta II., it passed away to Yaśodharman.§ From him, it passed, for a period of four

* See *ibid.*, Vol. II, p. 267.

† Perhaps a confusion with the poet Menṭha (or Mātrimenṭha?) who is said to have lived at his court.

‡ See Shanker P. Pandit's *Gaṇḍavaho*, Introd., p. lxxv.

§ Evidence of Yaśodharman's or Yaśovarman's imperial power are his coins

reigns, from c. A. D. 540 to 585, to the Maukharī dynasty, under Iśānavarman, Sarvavarman, Susthitavarman and Avantivarman. Three of these Varmans, Iśāna, Sarva and Avanti, receive the imperial titles, *mahārājādhirāja* or *paramēśvara* in two inscriptions.* Susthita is named in an inscription of the Later Guptas without any particular title;† but if he is not identical with Avantivarman—which is quite possible —, he must, in all probability, have been a Mahārājādhirāja, as the intermediate ruler between two Mahārājādhirājas (see column 8). That Susthita does not receive that title in the Gupta inscription is no objection; for neither does Iśāna receive it; the inscription, being one of the Later Guptas, who were a rival family, probably denied the imperial title to the Maukharīs as usurpers.‡

From the Maukharīs the imperial dignity passed to the Vardhana dynasty of Thanesar and Kanauj, for three reigns, under Prabhākara, Rājya and the great Harsha, from c. A. D. 585 to 648, though at some time between A. D. 613 and 634 it was disputed by the Early Chalukya king Pulikeśin II.§ After Harsha Vardhana the imperial dignity appears to have been held simultaneously in the West by the Valabhīs of Gujarāt (commencing with Dharasena IV., c. A. D. 645) and in the East by the Later Guptas of Magadha (commencing with Adityasena, c. A. D. 648). In the case of the Valabhīs, the assumption of the imperial dignity would seem, at first, to have been a temporary one. For after Dharasena IV., who enjoyed it from c. A. D. 645-650, it lapsed again, for about 20 years, during the two following reigns of Dhruvasena III. and Kharagraha II., neither of whom seem to have borne any imperial titles, perhaps owing to the rival emperor's, Adityasena's, ascendancy. About A. D. 670, however, Śīlāditya III. again became emperor of the West; and henceforth the imperial dignity remained with these two

with the legend of *kida* (see *Proceedings* for August, 1888). *Kida* would appear to be a tribal designation of the Hūnas.

* See Fleet, in *Corp. Inscr. Ind.*, Vol. III, pp. 218, 221.

† See *ibid.*, p. 206.

‡ It may be a question whether Yaśovarman or Yaśodharman did not himself belong to a branch of the Maukharī family of Varmans. There is nothing in Yaśodharman's inscriptions to prove that he belonged to the Málava tribes. His relation to the four imperial Maukharīs requires further elucidation. If, as above suggested, he is identical with the Śīlāditya, who according to Hsien Tsiang reigned 50 years, he must have been a contemporary and rival of the four imperial Maukharīs. The contemporary inscription of Asphaḍ would certainly seem to show, that the latter did not enjoy an undisputed title to the imperial dignity.

§ He assumed the imperial title *paramēśvara* after a thorough defeat of Harsha Vardhana; see *Indian Antiquary*, Vol. VII, p. 164. He had not done so before A. D. 613, nor was it after A. D. 634; see *ibid.*, Vol. VIII, p. 210.

dynasties of the Later Guptas and the Valabhís, apparently, till their respective extinction. Perhaps the coincidence of Jírita Gupta II., the last of the Later Imperial Guptas, with the Nepalese king Siva Deva II., who assumed the imperial titles, may have a deeper significance. For it may be noted, that about A. D. 648, at the time of the disruption of Harsha's empire, the Nepalese king, Amsuvarman, also laid claim to the imperial dignity in the North.

The Devagupta, placed in the third column of the synchronistic table, under the Later Guptas of Málava, is mentioned in the copper-plate grant of Harshavardhana,* as having been conquered by that king's brother and predecessor, Rájyavardhana II. He cannot be the Devagupta of the Later Gupta dynasty of Magadha (2nd column), as Harshavardhana himself was a contemporary of Mádhavagupta, the grandfather of that Devagupta. Moreover it is distinctly stated in the *Harsha-charita* of Báṇa, that the prince whom Rájyavardhana conquered, was a king of Málava †

In the seventh column of the Uchchakalpa Mahárájas it will be seen, that Sarvanátha reigned up to A. D. 533. His line, including himself, consists of six members; and the founder of the line, Oghadeva, was married to a queen Kumáradeví. Six reigns at an average of 18 years, would make Oghadeva (c. A. D. 425-445) a contemporary of Kumáragupta I. of the Early Gupta dynasty. It appears, probable, therefore, that Oghadeva's queen, Kumáradeví, was a sister or daughter of Kumáragupta I. ‡

* See *Epigraphia Indica*, Part II, p. 74.

† See Sh. P. Pandit's edition of the *Gaúdívaho*, Introd., p. cxxx.

‡ Mr. Fleet in the *Corpus Inscr. Ind.*, Introd. pp. 9, 10, suggests that the Uchchakalpa dates may have to be referred to the Kalachuri era. I do not understand how this could well be. Mr. Fleet says: "if the Uchchakalpa dates were referred to the Kalachuri era, with General Cunningham's epoch of A. D. 249-50, S'arvanátha's latest date, the year 214, would be equivalent to A. D. 463-64, or Gupta Samvat 144; and we should have to add on twenty-one years at the end of his known period, in order to make him the contemporary of Hastin in Gupta Samvat 165." But the crucial year appears to me to be not Gupta Samvat 165, but Gupta Samvat 189 (see *ibid.*, p. 110). For the joint-grant of Hastin and S'arvanátha was issued in the latter year. It follows, therefore, that we should have to add on, not twenty-one, but forty-five years; or if the epoch of the Kalachuri era be A. D. 248-49, even forty-six years. On the other hand, if the Kalachuri epoch be placed, as Mr. Fleet suggests, about 25 years later, let us say at A. D. 273-74 (i. e., 248-49 + 25), then S'arvanátha's latest date 214 Kalachuri Samvat will be equivalent to 163 Gupta Samvat; and in that case we should have to add on twenty-one years, in order to make S'arvanátha contemporary with Hastin in the year 189 Gupta Samvat. I assume, that when Mr. Fleet (*ibid.*, p. 111) says: "the choice lies only between Gupta Samvat 189 and 201," he means, that the only two years within the known period of Hastin's rule

The question may arise whether the Kumāragupta referred to in the Mandasor stone inscription of Bandhuvarman,* may not be the Kumāragupta II. of the Bhitari seal, rather than the Kumāragupta I., the only Gupta emperor of that name hitherto known. If it be Kumāragupta II., the three Varmans, Nara, Viśva and Bandhu, would have to be brought down nearly a century, so that Bandhuvarman would be the immediate predecessor of Yaśodharman (or Yaśovarman). I am disposed to think, however, that it is really Kumāragupta I. who is referred to in that inscription.

The metal of the seal has been tested by Dr. Scully of the Calcutta Mint. His analysis shows that it consists of

Copper	...	62.970	per cent.
Silver	...	36.225	„
Gold	...	0.405	„
Iron	...	trace.	“

In spite of its whitish grey colour, therefore, it is rather a copper than a silver seal.

The weight and dimensions of the seal have been determined by the

(i. e., between G. S. 156 and 191 or A. D. 475 and 510), with which the data of the joint-grant (i. e., the 19th day of the month Kārttika, in the Mahā-Māgha Sāmvatsara) can be made to harmonise, are G. S. 189 and 201 or A. D. 508 and 520. If this is so, the date of the joint-grant is practically certain: it is either A. D. 508-9 or A. D. 520-21, whether these years be stated in terms of the Gupta Sāmvat (189 or 201) or in terms of the Kalachuri Sāmvat (260 and 272). Upon these premises, there are these two alternatives: *firstly*, if we accept the year A. D. 218-19 (or 249-50) as the Kalachuri epoch, the known period of Ś'arvaūātha begins with Kalachuri Sāmvat 193, equivalent to A. D. 441-12, and he must have reigned not less than 67 years, to bring him down to A. D. 508 (= K. S. 260 or G. S. 189) to join Hastin in the issue of the grant; and he must have reigned even 79 years, to bring him down to A. D. 520 (= K. S. 272 or G. S. 201), if the latter be the year of the joint-grant. Neither of these two cases will be considered admissible. *Secondly*, if, as Mr. Fleet suggests, the Kalachuri epoch be placed about 25 years later, say A. D. 473-74, the beginning of Ś'arvaūātha's known period will be A. D. 466-67, and he must have reigned either 42 or 54 years, according as we place the joint-grant in A. D. 508 or in A. D. 520. Neither of these two latter cases is possible, especially the former, requiring a rule of (at least) 42 years. But there is no real evidence whatever for the assignment of the Kalachuri epoch to the year A. D. 473-74 or thereabouts. The result is, that the probability of the Uchchukalpa grants being dated in years of the Kalachuri era appears to be *nil*. My premises may be founded on a misunderstanding; if so, Mr. Fleet will be able to explain the real facts of the case. But I thought it well to state my doubts, which may have occurred to others beside myself.

* See Fleet, in *Corpus Inscr. Ind.*, Vol. III, p. 79.

same gentleman. The weight is 10,696 grains. The measurements are :

Greatest length	...	...	5.74 inches.
Greatest breadth	...	...	4.63 „
Breadth of rim	...	...	0.223 „
Height of rim above surface of plate	...	...	0.11 „
Thickness of seal (including rim)	...	...	0.39 „



JOURNAL

OF THE

ASIATIC SOCIETY OF BENGAL.



Part I.—HISTORY, LITERATURE, &c.

No. III.—1889.

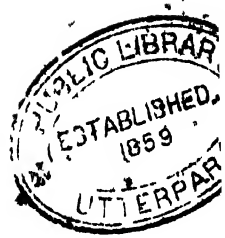
Græco-Roman Influence on the Civilization of Ancient India—By VINCENT
A. SMITH, Bengal Civil Service. (With several Plates.)

Section I. INTRODUCTION.

When the wearied veterans of “the great Emathian conqueror”, laden with plunder and sated with conquest, refused to cross the Hyphasis and to try the fortune of war in the valley of the Ganges, the exclusive, conservative East won a victory over the intruding, progressive West, which must have appeared to the actors on the scene as final and decisive.

But it was neither final nor decisive, for, though the obstacles opposed by hostile man and nature could stop the onward march of the Macedonian phalanx, nothing could arrest the sure and world-wide progress of the ideas and culture, which constituted the real strength of Hellas and were but rudely expressed by the disciplined array of Alexander’s armies.

India has not willingly sought the treasures of foreign wisdom, and, guarded by her encircling seas and mountains, she has tried, throughout the long course of ages, to work out her own salvation. She has tried, but has not succeeded. Again and again, both before and after Alexander, the barriers have been broken through, and her children, who would



fain believe that all light comes from the east, have been compelled to admit the rays of the western sun.

In the dim mist of prehistoric ages we can discern faint indications that India, in common with all regions of Asiatic and European civilization, drew supplies from those stores of Egyptian, Assyrian and Babylonian antique lore, which were, so far as we know or probably ever can know, the ultimate sources of the knowledge which distinguishes civilized man from the savage.

The history of those long past times is lost, and, save perhaps in some faintly sketched and dubious outlines, can never be recovered.

The Indian expedition of Alexander the Great in B. C. 327—326^a was, so far as our definite knowledge extends, the first occasion of close, conscious contact between East and West. The arms of the conqueror, it is true, subdued no more than a mere corner of India, and that only for a moment, but the Hellenic culture, to the diffusion of which Alexander devoted attention, as great as that bestowed by him on his material conquests, long survived his transitory empire in Asia, and, even in secluded India, made its presence felt in many and different directions.

I shall not attempt to penetrate the thick darkness which conceals the relations between India and the western world in the ages before Alexander, but propose to consider the kind and degree of post-Alexandrian influence on the ancient civilization of India, and to invite my readers' attention to an obscure and little known chapter in the ever-interesting history of Greek ideas.

The working of these ideas on Indian soil, although discernible in the fields of religion, poetry, science and philosophy, is most obvious in the domain of architecture and plastic art, and I shall devote the greater part of this essay to the consideration of Indo-Hellenic architecture and sculpture.

No Indian example in stone either of architecture or sculpture, earlier than the reign of *Aśoka* (*circa* B. C. 260—223), has yet been discovered, and the well-known theory of Mr. Fergusson, that the sudden introduction of the use of stone instead of wood for the purposes both of architecture and sculpture in India was the result of communication between the empire of Alexander and his successors, and that of the Mauryan dynasty of Chandra Gupta and *Aśoka*, is, in my opinion, certainly correct. The change from wood to stone indubitably took place, and no other explanation has ever been suggested.

I shall not, however, now discuss Mr. Fergusson's theory, but shall proceed to examine particular cases of undoubted and incontestable Hellenistic, including Roman, influence on the Indian development of the arts of architecture and sculpture.

A brief discussion of the more prominent effects of the contact between the Græco-Roman and Indian civilizations on other departments of human activity in India will follow, and will enable the reader to form a conception as a whole of the impression made by the West upon the East during a period of seven or eight centuries. That impression was not sufficiently deep to stamp Indian art, literature and science with an obviously European character, although it was much deeper than is commonly supposed.

Section II. INDO-HELLENIC ARCHITECTURE.

The style of architecture, appropriately named Indo-Persian by Sir Alexander Cunningham, and obviously derived from that employed in the Achæmenian palaces of Susa and Persepolis, was extensively used throughout Northern and Western India for several centuries both before and after the Christian era. With this style of western, though not Hellenic, origin the history of Indian architecture begins. It would be more strictly accurate to say that with this style the history of Indian architectural decoration begins, for no buildings in it exist, and we know its character only from pillars and miniature representations in sculptured reliefs.

The pillars are characterized by "a bell-shaped lower capital, surmounted by an upper member formed of recumbent animals, back to back."* The series of examples in Northern India, of pillars more or less fully corresponding to this definition, begins with the monoliths of Asoka (circa B. C. 250), and ends with the pillar of Budha Gupta at Eraṇ in the Sâgar District of the Central Provinces, which bears an inscription dated in the year A. D. 485.† The caves of Western India offer examples apparently rather later, and specimens of intermediate dates have been found at Bhârhut, Buddha Gayâ, Sânci, Beṣṣâ, and Mathurâ, as well as in the Gândhâra or Yûsufzai country. But there is no evidence as yet forthcoming that Indo-Persian pillars were used structurally in Gândhâra. In miniature, as architectural decorations, they were a favourite ornament in that region.

The Indo-Persian pillar underwent gradual modifications in India Proper, with which I am not at present concerned. On the north-west frontier of India, that is to say, in the western districts of the Panjâb, in the valley of the Kâbul River, including Gândhâra or the Yûsufzai country, and in Kâshmir, it was supplanted by pillars imitated from

* Cunningham, *Archæol. Rep.*, Vol. V, p. 185. [For a convenient synopsis of specimen pillars of the Persian, Indo-Persian, Indo-Hellenic (Corinthian) and Indo-Doric styles, see *ibid.*, Plates XXVII, and XLV to L. Ed.]

† All the Gupta dates are determined in Mr. Fleet's work on the Gupta Inscriptions, *Corpus Inscript. Indicarum*, Vol. III.

Greek models. Isolated examples of Indo-Hellenic pillars probably existed in other regions also, associated with the specimens of Hellenized sculpture which occur at Mathurá and some other localities remote from the Panjáb frontier, but, as yet, none such have been discovered, and, speaking generally, the Hydaspes or Jhelam river may be assigned as the eastern boundary of Indo-Hellenic architectural forms.

The evidence does not, to my mind, warrant the use of the term "Indo-Grecian styles of architecture," which is employed by Sir A. Cunningham. So far as I can perceive, the published plans of Indian buildings show no distinct traces of Greek ideas, and there is no evidence of the employment of the characteristic Greek pediment or entablatures. The known facts prove only that the Indians used, in buildings planned after their own fashion, pillars copied, with modifications, from Greek prototypes.

In the outlying province of Káshmir and the dependent region of the Salt Range a modified form of the Doric pillar was employed. The earliest example of the use of this form is found in the temple of the sun at Mártanḍ, which was erected not earlier than A. D. 400, and perhaps should be dated two or three centuries later. Temples in a style similar to that of Mártanḍ appear to have continued to be erected in Káshmir down to the time of the Muhammadan conquest of the valley. They are characterized by trefoiled arches, and pyramidal roofs, and were frequently, if not always, built in the centre of shallow tanks. These peculiarities are in no wise Greek. The pillars undoubtedly, as Sir A. Cunningham observes, resemble the Grecian Doric in "the great ovolo of the capital, and in the hollow flutes of the shaft." It is difficult to believe that the agreement in these respects between the Greek and Indian work is accidental, but it is also difficult to imagine the existence of a channel through which the Kashmirians borrowed the Doric form of pillar at a time when every other manifestation of Hellenic ideas had already disappeared, or was on the point of disappearing, from India.

I cannot venture to deny the Greek origin of the semi-Doric pillars of the temples in Káshmir, although I am not satisfied that it is fully established. Even if it be admitted, the admission is hardly sufficient to warrant the assertion that the Kashmirian buildings are examples of an Indo-Doric style. The most that can be correctly affirmed is, that these buildings contain pillars which may fairly be described as Indo-Doric. These Indo-Doric pillars, if there be indeed anything Doric about them, are never associated with Indo-Hellenic sculpture, or anything else which gives the slightest indication of Greek influence. The Káshmir style stands apart, and the study of it throws little light either on the history of Indian architecture, or on that of the diffusion of Greek ideas. I shall, therefore, exclude it from consideration, and

refer readers who may care for further information on the subject to the discussion of it by Mr. Fergusson and Sir A. Cunningham, and to the fine series of plates prepared under the supervision of Major Cole.*

But, whether the pillars of the Káshmir temples be really derived from Doric prototypes or not, there is no doubt whatever that pillars, the designs of which are modifications of the Ionic and Corinthian types, were common on the north-west frontier of India during the early centuries of the Christian era.

These Greek architectural forms have as yet been found only in a very limited area, which may be conveniently referred to under the name of Gándhára.†

The boundaries of the kingdom of Gándhára, as it existed in ancient times, are known with approximate accuracy. Hiuen Tsiang, who travelled between A. D. 629 and 645, describes the kingdom as extending about 166 miles (1000 *li*) from east to west, and 133 miles (800 *li*) from north to south, with the Indus as its eastern boundary. The great city of Purushapura, now known as Pesháwar, was then the capital.‡ The earlier Chinese traveller, Fa Hian (A. D. 400—405), assigns the same position to the kingdom of Gándhára, though he describes its boundaries with less particularity.§

The region referred to by both Chinese pilgrims may be described in general terms as the lower valley of the Kábul river. It is very nearly identical with the territory to the north-east of Pesháwar, now inhabited by the Afghán clan, known as the Yúsufzai or Sons of Joseph, which comprises the independent hilly districts of Swát and Buhner, as well as the plain bounded on the east by the Indus, on the north by the hills, and on the south and west respectively by the Kábul and Swát rivers. This plain, which is attached to the Pesháwar District, and administered by British officers, corresponds to the tract known to the Greeks as Peukeloaitis (Sanskrit *Pushkaláwatí*), the capital of which occupied the site of the modern Hashtnagar, eighteen miles north of Pesháwar.||

* Major Cole's book is entitled *Illustrations of Ancient Buildings in Káshmir*, (London, India Museum, 1869). His plates are good, but his remarks on the dates of the buildings illustrated would have been better omitted. Mr. Fergusson discusses the style in his *History of Indian and Eastern Architecture*. Sir A. Cunningham described it in the *Journal, Asiatic Society, Bengal*, for 1848, and recurs to the subject in *Archæol. Reps.*, Vol. V, pp. 84-90, Plates XXVI, XXVII; Vol. XIV, p. 35, Pl. XV.

† Sanskrit authority warrants either a long or short vowel in the first syllable of the name.

‡ Beal, *Buddhist Records of the Western World*, Vol. I, p. 97.

§ Fa Hian, *Travels*, Chapter X, in either Beal's or Legge's translation.

|| Cunningham, *Archæol. Rep.*, Vol. V, p. 1. Hashtnagar is described *ibid.*, Vol. II, p. 90, and Vol. XIX, pp. 96—110.

Strictly speaking, therefore, the name Gándhára is applicable only to a small territory west of the Indus.

But the great city of Taxila, (Takkhasilá, or Takshasilá, the modern Sháh kí Dherí), situated three marches, or about thirty miles, east of the Indus, was undoubtedly, in the time of Alexander the Great, the chief city on the north-western frontier of India, and must have been then, as it subsequently was in the reigns of Ásoka and Kanishka, included in the dominions of the government which ruled Gándhára. Kanishka is expressly called the king of Gándhára.*

The vast Buddhist religious establishments at Mánikyála, about thirty miles south-east of Taxila, belonged to the same jurisdiction, and at both places remains are found of that Indo-Hellenic school of art, which attained its chief development in Gándhára west of the Indus. The name of Gándhára, as indicating an artistic and architectural province, may, therefore, be extended, as it was by Mr. Fergusson, so as to comprise the modern districts of Pesháwar and Ráwalpindí, including Taxila and Mánikyála, as far east as the Hydaspes or Jhelam river. When speaking of the art of Gándhára I must be understood as employing the name in its wider sense.

The upper valley of the Kábul river was full of Buddhist buildings, many of which have been explored by Masson and others, and was included in the dominions of Kanishka and his successors. But, so far as the published accounts show, this region was only slightly affected by Hellenic influences, and it must, for the present at all events, be considered as outside the artistic province of Gándhára.

The Gándhára territory, the situation of which has thus been defined, was the principal seat of Hellenic culture in India, and from one or other part of it nearly all the known examples of Indo-Hellenic art in its most characteristic forms have been obtained. Traces of Greek and Roman teaching may be detected in the remains at many localities in northern and western India, but nowhere with such distinctness as in the lower valley of the Kábul river. The Gándhára school of art obviously deserves, though it has not yet obtained, a place in the general history of Greek architecture and sculpture, and this cannot be said of the other early Indian schools.

At Bhárhut, Sánchi, Buddha Gayá, Ajanṭá, and Amarávatí proofs may be given that the local style of art was modified by contact with

* A full account of the ruins of Taxila will be found in Cunningham, *Archæol. Rep.*, Vol. II, pp. 112, *seqq.*; Vol. V, pp. 86, *seqq.*, and Vol. XIV, pp. 9, *seqq.* Fa Hian states that Dharma Vardhana (or Vivardhana, as Dr. Legge writes the name), son of Ásoka, ruled in Gándhára, and, according to another legend, the stúpa in memory of Ásoka's son Kunála was situated south-east of Taxila, (Cunningham, *Archæol. Rep.*, Vol. II, p. 149.)

that of the western world, but the evidence does not lie upon the surface. In the remains of the buildings and sculptures of Gándhára the merest tyro can perceive at a glance that the style of art is in the main Greek or Roman, not Indian.*

* The principal references to published notices of the Gándhára school of art are as follows ;—

(1) *Notes on some sculptures found in the District of Pesháwar.* By E. C. Bayley. With several rude lithographs. (*Journal As. Soc., Bengal*, Vol. XXI (1852), pp. 606—631). The sculptures described in this paper were collected at Jamálgarh by Messrs. Lumsden and Stokes, and were destroyed by the fire at the Crystal Palace.

(2) *Indian Antiquary*, (Bombay), Vol. III, pp. 143, 159.

(3) *History of Indian and Eastern Architecture.* By James Fergusson.

(4) *Reports of the Archaeological Survey of India, Vol. V.* By Sir A. Cunningham. Volume II of the same series gives information concerning Taxila. See also Vol. XIV, p. 31, Pl. XIV.

(5) *Descriptive List of the Principal Buddhist Sculptures in the Lahore Museum*, p. 11. This list, kindly supplied to me by the Curator, contains brief particulars of 95 specimens, of which 32 are marked with an asterisk, as being either “in exceptionally good preservation, or interesting from their subjects.” The list is signed by Sir A. Cunningham, but is not dated. Two specimens are noted as coming from Sahri Bahlol, and one is stated to have been obtained in the fortress of Rápnigat, but no other indication is given of the localities from which the sculptures were obtained.

I have not been able to procure a “*Memorandum by Mr. Baden-Powell on the sculptures in the Lahore Museum*,” which is referred to by Sir A. Cunningham, *Archæol. Rep.*, Vol. V, p. 55, note 1.

(6) *Catalogue and Handbook of the Archaeological Collections in the Indian Museum.* By John Anderson, M. D., F. R. S., etc. Part I, Calcutta, 1883. 201 Indo-Hellenic objects are described, viz., 177 arranged under the heading Gándhára, 18 under Pesháwar, two under Mathurá, and one each under Hazára, Kábul, miscellaneous, and Bihár.

(7) *Memorandum on Ancient Monuments in Eusufzai (sic).* By Major Cole; being part of the Second Report of the Curator of Ancient Monuments in India, pp. CXIV, seqq. This document was separately reprinted at the Government Central Branch Press, Simla, 1883. It is illustrated by rough lithographic plates, comprising all the subjects subsequently treated by the heliogravure process, as well as by a map of the Yúsufzai country, and eleven other plans and sketches.

(8) *Preservation of National Monuments, India, Græco-Buddhist Sculptures from Yúsufzai.* By Major H. H. Cole, R. E. Published by order of the Governor-General in Council for the office of Curator of Ancient Monuments in India. Large folio, p. 7, with 80 very fine heliogravure plates, 1885.

(9) *The Buddhist Stúpas of Amarávatí and Jaggayapeta.* By James Burgess, C. I. E., etc, Archaeological Survey of Southern India. Trübner, London, 1887. This work does not describe the sculptures, but some good specimens of them are figured in woodcuts Nos. 1, 4, 11, 14, 21, 23, 24, and 26, which are copied from the illustrated edition of Sir E. Arnold's *Light of Asia*.

(10) *Alt- und Neu-Indische Kunstgegenstände aus Professor Leitners jüngster*

No indication of a knowledge of the Doric order of architecture can be detected in the remains of the buildings of Gándhára. With two exceptions, the only Greek architectural form used is a modification of the Corinthian pillar and pilaster.

The two exceptions both occur to the east of the Indus, outside the limits of Gándhára proper.

On the site of Taxila Sir A. Cunningham disinterred the remains of a Buddhist temple, the portico of which was supported on four massive sandstone pillars of the Ionic order. Similar, though smaller, pillars were found in the interior of the building. No part of the larger pillars was discovered, except their bases. The mouldings of these bases are said to correspond exactly with those of the pure Attic base, as seen in the Erechtheum at Athens, the only difference being the greater projection of the fillet below the upper torus in the Indian example.

Portions of the shafts and capitals of the smaller pillars were found. The shafts are circular in section and plain. The capitals were made of nodular limestone, and appear to have been plastered and gilded. They agree generally in form with Greek, not Roman, models, but are ruder and more primitive in style, and are specially distinguished from all

Sammlung, ausgestellt in K. K. Österr. Museum für Kunst und Industrie, Stubenring 5. Verlag des K. K. Österr. Museum's Wien, 1883.

The specimens of the Gándhára school of art preserved in museums are very numerous. The principal collection is that in the Lahore Museum. It is very extensive, numbering many hundred objects, but seems to be badly arranged. I have not seen it. The collection next in importance is that in the Indian Museum, Calcutta. Dr. Anderson's carefully compiled Catalogue gives a good idea of its contents. Major Cole intended to send spare specimens to the museums at Bombay, Madras, and some other places, which were, I suppose, sent.

In London the best collection, though not an extensive one, is that which occupies cases Nos 1—7 in the Asiatic Saloon of the British Museum. The South Kensington collection is officially described as comprising 24 sculptures in stone, and 49 plaster casts from originals in the Lahore Museum, presented by Sir R. Egerton in 1882. When I examined the specimens in 1888, they were exhibited partly in a glass case, partly on a detached screen, and the rest on a wall screen. Dr. Leitner's collection at Woking comprises some original sculptures and a considerable number of casts from the works in the Lahore Museum. It is described in the printed Catalogue above cited.

The Museum at Vienna contains some specimens presented by Dr. Leitner, and many examples of the work of the school are believed to exist in private hands both in Europe and India. Sir A. Cunningham possesses a valuable series of photographs of the more remarkable sculptures. Mr. Kipling, Curator of the Lahore Museum, informs me that he intends to arrange for the publication of a set of photographs of Indo-Hellenic art. The specimens in the possession of Mr. L. White King, B. O. S. will be noticed subsequently.

known Greek examples by the excessive weight and height of the abacus.*

The employment of stucco to conceal the roughness of the limestone and to facilitate the execution of the moulding reminds us of the temple of Fortuna Virilis at Rome, where the same expedient was used to complete the decorative work on Ionic capitals made of rugged travertine.†

Sir A. Cunningham subsequently discovered among the ruins of Taxila in another temple the bases and portions of the drums of two Ionic pillars, differing slightly in detail from those above described.‡

These two buildings are the only known examples of the use of the Ionic form of pillar in India.

The rude style of the capitals in the building first discovered—the only ones yet found—might suggest the fancy that the Taxilan temples preserve specimens of the primitive Ionic order in its Asiatic form, before it was developed by Greek skill. But the evidence of the comparatively late date of the temple adorned by these rude capitals is too clear to allow indulgence in such a notion. The building cannot, apparently, be earlier than B. C. 20 or 30, the approximate date of king Azes, twelve of whose coins were lifted out by Sir A. Cunningham with his own hand from their undisturbed resting place below the floor of the sanctum, and under the corner of a platform which had supported a number of plaster Buddhist statues.§ The date of the temple may therefore be assigned roughly to the beginning of the Christian era, at which time, it need not be said, the Ionic order had long been fully developed. The question of date will be considered more fully in a later section.*

The Taxilan temples with Ionic pillars were, like all the known examples of Indo-Hellenic architecture, dedicated to the service of the Buddhist religion. Sir A. Cunningham gives a plan of the one first discovered, from which it appears that the whole edifice was 91 feet long by 64 feet broad, standing on a platform, which projected about 15 feet beyond the walls on all sides except the east, forming a terrace adorned with plaster statues. It is supposed that this terrace was roofed in as a cloister. The entrance was on the east, in the centre of one of the larger sides, through a portico supported on four Ionic columns. This portico led into an entrance hall, $39\frac{1}{2}$ feet long from north to south, by $15\frac{1}{2}$ feet broad from east to west. The sanctum or cella of the temple lay behind this, with a length of 79 feet from north to south,

* Cunningham, *Archæol. Rep.*, Vol. II, p. 129; Vol. V, pp. 69, 190.

† Burn, *Roman Literature and Art*, p. 204.

‡ Cunningham, *Archæol. Rep.*, Vol. XIV, p. 9, Pl. VII.

§ Cunningham, *ibid.*, Vol. V, pp. 72, 190.

and a breadth of $23\frac{1}{2}$ feet from east to west. This room, except at the wide doorway, was surrounded by a bench 4 feet $8\frac{1}{2}$ inches broad, and 2 feet high, which supported plaster statues of Buddha, with his hands either resting on his lap or raised in the attitude of teaching. It is remarkable that the hair of these figures was rendered by the conventional curls, which are so commonly associated in later times with Buddhist and Jain art. Unluckily no drawings or photographs of these plaster figures have been published, and it is impossible to say whether they were coeval with the Ionic pillars or not. I should not have expected to find plaster statues at the beginning of the Christian era, and I suspect that the images are of considerably later date than the pillars.

Sir A. Cunningham believes that the roof was constructed mainly of wood, and that the chambers were lighted by windows in the upper part of the walls, which projected above the roof of the surrounding cloister. He conjectures that the four portico pillars "must have been intended to support a vaulted roof presenting a pointed arch gable to the front, as in the smaller chapels across the Indus." A small room, 20 feet $1\frac{1}{2}$ inch long by $15\frac{3}{4}$ feet broad, communicated with each end of the entrance hall.

The reader will not fail to observe that the plan and elevation of this temple have little in common with those of Greek temples.

I agree with Sir A. Cunningham and Mr. Fergusson in regarding the buildings with Ionic pillars at Taxila as the oldest architectural remains yet discovered in the Gándhára province, and I shall subsequently attempt to show that a considerable interval separates them from the numerous edifices characterized by a lavish use of Corinthian pillars and pilasters.

The fact that the Corinthian pillars and pilasters were used, much in the same way as they are in many modern European buildings, for decorative purposes applied to buildings of native design, and not as members of an "order" in the technical sense, is clearly proved by the manner in which Indo-Persian and Indo-Corinthian forms are employed together. No styles can be more diverse than these, and yet the Gándhára architects felt no scruples about employing them both in the one building, or even in the one sculpture. The first plate in Major Cole's set of beautiful heliogravures affords a good illustration of this purely decorative use of two diverse styles. The subject of the plate is an alto-relievo of the seated Buddha embellished by numerous minor figures and architectural decorations. The latter chiefly consist of combinations of Indo-Persian pillars with plain "Buddhist railings" and ogee-shaped façades, while the pilasters at the lower corners of the slab have acanthus leaf capitals in the Indo-Corinthian style. This sculpture was probably executed in the third century A. D.

Although there is no reason to suppose that the Gándhára buildings adorned with Corinthian pillars were Greek or Roman in plan or elevation, the remains excavated, especially those at Jamálgarhí, prove that such pillars, both circular and square in section, were used for structural support, as well as for sculptural decoration.

No piece of Corinthian shaft has yet been discovered. The testimony of the sculptures is not conclusive, but, so far as we can judge from the miniature pillars and pilasters in the reliefs, the shafts were plain, not fluted.

The incomplete lower parts of the bases of two structural pillars have been found, and a comparison of their dimensions with those of the pillars in the famous choragic monument of Lysicrates at Athens (B. C. 334) has satisfied Sir A. Cunningham that the Indian examples differ from the Greek standard "solely in giving an inward slope to the perpendicular narrow fillet which separates the scotia and torus.

"In both the Indian examples it will also be observed that the torus, or round projecting moulding, is thickly foliated, like that of most of the Corinthian bases. Of the upper part of the base not even a fragment has yet been found; and the representations in the bas-reliefs do not offer any assistance, as they show only one large and one small torus, separated by an astragal, and altogether want the deeply marked scotia which forms the leading characteristic of the Corinthian base, and which is carefully preserved in both of the full-sized Indian specimens."

The foliation referred to is not found on the bases of the pillars of the monument of Lysicrates, and is, I think, purely Roman decoration. I shall subsequently give reasons for dating the Gándhára pillars between A. D. 250 and 350, and for holding that all the Indian buildings adorned with Corinthian pillars were constructed under the influence of Roman art. The remains of structural Indo-Corinthian capitals, found chiefly at Jamálgarhí and Takht-i-Bahí, are numerous, but unfortunately are never perfect, owing to the brittleness of the clay slate in which they were carved, and to the practice of constructing each capital from many pieces bound together by iron cramps. The lower portion of the larger capitals, some of which measure about three feet in diameter, was made in from two to four pieces; the upper portion always consisted of four segments.

The British Museum possesses some fine examples of these capitals collected by Sir A. Cunningham at Jamálgarhí, and smaller specimens may be seen in the collection at South Kensington. Others are preserved in the Indian Museum, Calcutta, and in the Lahore Museum.*

*. Plates XLVII—L of Cunningham's *Archæol. Rep.*, Vol. V, are devoted to the illustration of Indo-Corinthian pillars. The restoration of elephants on the top of a

Sir A. Cunningham, who was unwilling to recognize Roman influence on the art of Gāndhāra, compares the Indo-Corinthian capitals with those of "the pure Corinthian order of Greece" as follows:—

"The chief points of similarity are:—

1st. The three rows of acanthus leaves, eight in each row, which are arranged round the drum or bell of the capital.

2nd. The broad, but not deep, volutes at the four corners.

3rd. The four pointed abacus with a curved recess in the middle of each side.

The most marked points of difference are the following:—

1st. The wide spread of the abacus, which is equal to $2\frac{1}{2}$ heights of the whole capital, that of the Greek examples being little more than $1\frac{1}{2}$ height.

2nd. The retention of the points at the four corners of the abacus, which in all the Greek examples have been cut off.

3rd. The insertion of a fourth row of acanthus leaves which is projected forward to the line joining the horns of the abacus. The abacus is thus formed from a square having a curved recess on each side of the central projection.

4th. The placing of flowers on the abacus which are supported on twisted stems springing from the roots of the volutes. In a single instance fabulous animals are added to the flowers on the horns of the abacus.

5th. The insertion of human figures amongst the acanthus leaves, whose overhanging tufts form canopies for the figures."

I have quoted this passage in full, not because I attach much value to the comparison made in it, but because it gives an authoritative description of the characteristic features of the Indo-Corinthian capitals. Sir A. Cunningham cannot help admitting the resemblance between those specimens which exhibit human figures among the foliage and Roman capitals found in the ruins of the baths of Caracalla, but avoids the natural conclusion, and boldly declares that, if the design for these capitals with human figures was suggested by any earlier works, "the suggestion must have come from the creative Greeks of Ariana, and not from the imitative Romans."* On the other hand, I am fully convinced, as I shall try presently to prove, that the design in question did come "from the imitative Romans," and that the art of Gāndhāra is essen-

capital shown in Pl. XLVIII is conjectural, and not supported by adequate evidence. Two of the Jamālgarhī capitals are figured in Fergusson's *History of Indian and Eastern Architecture*, and a rough sketch of one specimen from the same place is given in *Indian Antiquary*, Vol. III, p. 142.

* Cunningham, *Archæol. Rep.*, Vol. V, pp. 192—194.

tially Roman in style. The Jamálgarhí carvings date, I believe, from about the middle of the third century A. D., and can be usefully compared in detail only with the similar work in contemporary, or nearly contemporary, Roman buildings. It is waste of trouble to make elaborate comparison of their details with those of the monument of Lysicrates, which was erected about six hundred years previously, but I am not sufficiently acquainted with the minutiae of architectural criticism to pursue the subject further, and must leave to others the task of accurately verifying the various differences and resemblances between the Indo-Corinthian and Romano-Corinthian styles. Probably, however, the task would not justify the labour bestowed upon it.* If the Roman origin of the Indo-Corinthian style be admitted, very minute study of variations in detail may be deemed superfluous, great variation in the embellishment of Corinthian capitals being everywhere allowed and practised.

Section III.

THE GÁNDHÁRA OR PESHÁWAR SCHOOL OF SCULPTURE DESCRIBED.

A specimen of sculpture, apparently Indo-Hellenic in style, and closely related to the work of the Gándhára school, was discovered at Kábul in 1833,* but the first distinct announcement of the existence of a school of Hellenic art in India was made in 1836 by James Prinsep, the founder of scientific Indian archæology, who published in that year at Calcutta a description, illustrated by rude plates, of the so-called Silenus group procured by Colonel Stacy at Mathurá. This group, though undoubtedly Indo-Hellenic in style, is not the work of the Gándhára school. It will be discussed in the next following section.

The ruins of the monastery at Jamálgarhí, north-east of Pesháwar, were discovered by Sir A. Cunningham in 1848, but he did not publish any account of his discovery till many years later.

The first published account of the Gándhára sculptures is that written by the late Sir E. C. Bayley, who printed in the Journal of the Asiatic Society of Bengal for the year 1852 an account, illustrated by

* *Journal Asiatic Society of Bengal*, Vol. III, p. 362, Pl. XXVI, fig. 1; Anderson's *Catalogue*, Part I, p. 261 (K. 1). The sculpture is circular, 15½ inches in diameter, and represents the seated meditating Buddha with flames proceeding from his shoulders, and surrounded by subordinate figures. It was discovered in November, 1833, in ruins two miles south-east of the city of Kábul, enclosed in a large and beautifully roofed square masonry cell, "handsomely gilt, and coloured by lapis lazuli, which is found in considerable quantities in the mines of Badakshán, twelve days' journey from Kábul." Lapis lazuli has also been found on the site of Taxila, and at Baoti Pind in the Ráwalpindí District. (Cunningham, *Archæol. Rep.*, Vol II, pp. 117, 141).

the roughest possible sketches, of some remarkable sculptures found at Jamálgarhí. The works, thus imperfectly illustrated, were subsequently brought to England, and exhibited in the Crystal Palace, where they were destroyed by the disastrous fire which also consumed Major Gill's copies of the paintings on the walls and ceilings of the Ajanta caves.

Prinsep's and Bayley's description of the works of Indo-Greek sculptors failed to attract general attention, probably owing to the extreme rudeness of the illustrative plates. Dr. Leitner, who brought to Europe in 1870 a considerable collection of works of art, to which he gave the name of Græco-Buddhist, is entitled to the credit of being the first to interest the learned world in the existence of a school of Indo-Hellenic architecture and sculpture.

Though the Greek influence on the style of the works exhibited by Dr. Leitner, and on the many similar objects since discovered, is now universally admitted, it is remarkable that, so late as the year 1875, at least one writer of repute denied its existence.

"It has become a fashion recently," wrote the late Mr. W. Vaux, F. R. S., "to extend a Greek influence to districts east of Bactria, for which I venture to think there is really but little evidence. Thus, we are told that certain Buddhistic figures, chiefly in slate, procured by Dr. Leitner and others to the north-east of Pesháwar, exhibit on them manifest traces of Greek art. I am sorry to say that I cannot perceive anything of the kind."*

The Greek influence on the Gándhára sculptures, which Mr. Vaux could not perceive, is so obvious to other critics, that a formal refutation of his ill-founded scepticism would now be superfluous. Professor Curtius has rightly observed that the discoveries of Dr. Leitner, Sir A. Cunningham, and other explorers in the Kábul valley, "open a new page in the history of Greek art."†

The new page thus opened has as yet been little read, and I venture to hope that the following description of a few of the most noteworthy examples of Indo-Hellenic art, and discussion of the sources from which it was derived, may attract both classical and Oriental scholars to the further exploration of a field hitherto very imperfectly worked.

The present section will be devoted to the description of some of the more remarkable and characteristic specimens of the work of the

* *Numismatic Chronicle*, Vol. XV, N. S., p. 12, *note*.

† *Abhandlung über die Griechische Kunst*, as quoted in Dr. Leitner's Catalogue. I believe the paper was published in the *Archæologische Zeitung* for 1875, but I have not seen it.

very prolific sculptors belonging to the Gándhára school. The chronology and artistic relations of the school will be separately discussed in a subsequent section; at present I shall refer only very briefly to these topics.

The oldest known example of Indo-Hellenic sculpture in the Panjáb probably is the statuette in purely Greek style of Pallas Athéné, the original of which is in the Lahoré Museum. Dr. Leitner has a good cast of this work in his museum at Woking, and Sir A. Cunningham possesses a photograph of it. It is shown in Plate VII.

The attitude of the goddess is that represented on certain coins of Azes, which show her helmeted, standing, facing front, crowning herself with her right hand, and holding in her left hand a spear obliquely across her body. The goddess of the coins carries a shield also on her left arm, but the statuette is imperfect, and the shield has been lost.*

The close relation of this sculpture to the coins of Azes proves that it must be approximately contemporary with that prince, that is to say, that it dates from the beginning of the Christian era, or possibly a few years earlier. It therefore belongs to the same period as do the Ionic pillars of the Taxilan temples. The statuette is said to have been found somewhere in the Yúsufzai country, but the exact locality where it was discovered does not seem to be known.

I shall explain subsequently my reasons for thinking that this statuette of Pallas is a relic of Indo-Hellenic sculpture properly so called, as distinguished from the Indo-Roman school to which all, or almost all, the other examples of Gándhára art belong.

The effigy of the virgin goddess of Athens cannot be certainly connected with any Indian religious system, and we cannot say whether the statuette above described formed part of the decoration of a Buddhist temple or not. But in all probability it did, for every specimen of Indo-Hellenic sculpture from Gándhára, the find-spot of which is known, belonged to a Buddhist building of one sort or another.

Most of the sculptures are evidently Buddhist in subject, but some of them, notably the figures supposed to represent kings, deal with secular subjects, though used to decorate edifices consecrated to the service of religion.

* Gardner, *Catalogue of Coins of Greek Kings of Bactria and India*, Plate XVIII, 4. Cunningham, in his *Descriptive List* (No. 21), observes, "The lower right arm, which probably bore the ægis with the head of Medusa, has been lost." This remark is evidently erroneous. The goddess on the coins carries, as might be expected, the shield on her left arm, and grasps the spear with her left hand. Her right arm is raised, with the hand to her head, as for the purpose of crowning herself.

Dr. Leitner and Sir A. Cunningham both consider that the most striking piece in the extensive collection at the Lahore Museum is the figure of a throned king, resting his left foot on a footstool, and grasping a spear in his left hand. See Plate VIII. The upper part of the body is naked, the head-dress is rich, and the squarely cut eyes are remarkably prominent. The work is in good preservation, the right arm alone being wanting. The king's attitude is easy, his expression is dignified, and the outlines of his figure are boldly drawn. Small figures, which have been conjectured to represent conquered aborigines, are attached to the right and left. The identity of the attitude of the principal figure of this fine group with the attitude of the Indo-Scythian kings as shown on their coins naturally suggests that the sculpture represents one of these sovereigns. I do not know where the sculpture was found.*

Sir A. Cunningham found at Jamálgarhí fifteen or sixteen statues, some seated, and some standing, which he supposes to be those of kings, and observes that "these royal statues are known by their moustaches, and the numerous strings of gems worked into their head-dresses. The arrangement of the hair is different in each separate specimen, and, as the features also differ, there seems little doubt that they are portrait statues."†

In the case of one statue in the Lahore Museum, (No 6 of Descriptive List, and No. 63 of Dr. Leitner's Catalogue), which Professor Curtius compares with the Greek ideal type of Apollo, the royal character of the person portrayed is unmistakably indicated by the presence of the regal fillet, the ends of which float loosely behind his head, in the same way as they are shown on the coins of Greek princes both of Europe and Asia.

It is hardly possible that all these so-called royal statues can be intended as ideal representations of Buddha as Prince Siddhártha, before he adopted the religious life, though some of them probably should be so interpreted. Mr. Fergusson suggested that they should be regarded as images of Buddhist saints, and the presence of the nimbus behind the head in many cases supports this suggestion.‡

The presence or absence of moustaches proves nothing, for Buddha is frequently represented as wearing moustaches in the works of the Gándhára school. If the images in question were portrait statues, as suggested by Sir A. Cunningham, they would probably be inscribed. It seems hardly credible that sculptors would execute numerous portraits of Kanishka and other kings without taking the trouble of indi-

* Cunningham, *Descriptive List*, No 2; Leitner, *Catalogue*, No. 78.

† Cunningham, *Archæol. Rep.*, Vol. V, pp. 197, 202.

‡ *History of Indian and Eastern Architecture*, p. 179.

coating for whom the portraits were intended. I think it more likely that these so-called royal figures are not portraits of individuals, but that they are ideal representations, in some cases of kings, and in some cases of saints.

The museums in London and Calcutta possess several examples of sculptures of this class. Two from the upper monastery at Nuttu are depicted in Major Cole's heliogravure plates Nos. 24 and 25. The statue or statuette shown in the latter plate represents a man of dwarfish figure, standing, as if preaching, with a nimbus behind his head. The legs are thick and badly executed, and the work seems to me to be of comparatively late date, probably subsequent to A. D. 300. This figure, in spite of the ornaments and moustaches, appears intended to represent a preaching saint rather than a king.

The works above described were all, so far as is known, associated with Buddhist buildings, though in themselves not obviously Buddhist in subject. I shall now proceed to describe sculptures, the subjects of which are taken from the rich stores of Buddhist mythology.

The birth-scene of Gautama, or Prince Siddhārtha, who in after days won the honourable title of the Buddha, or the Enlightened, is a favourite subject with Buddhist artists, and recurs in their works almost as frequently as representations of the Nativity are met with in Christian art.

Sir A. Cunningham, in the catalogue of sculptures excavated, chiefly at Jamálgarhí, under his supervision, enumerates four examples of this favourite subject, two of which are now in the Indian Museum, (*G. 1 and 2*).* See Plate IX, fig. 1. Major Cole gives a plate of a tolerably well-preserved specimen discovered at the upper monastery of Nuttu during subsequent explorations in the Yúsufzai country.†

According to Buddhist belief, Máýá Deví, the Buddhist Madonna, was standing under a *sál* tree, when she gave birth to the holy infant, who sprang from her right side, and was received in a golden net by Brahmá, attended by the *devas*, or angels. This legend appears to be, like the sculptures which express it, descended from a Greek original. Mr. Beal has pointed out that, in several respects, it closely resembles the Greek myth of the birth of Apollo in Delos.‡

The details of the scene vary considerably in different sculptures, but the traditional grouping of the principal figures is never materially changed. The description of one specimen will, therefore, suffice for all.

* Dr. Anderson's *Catalogue*, Part I, pp. 199, 202.

† Seven examples of sculptures of the nativity of Buddha preserved in the Lahore Museum are enumerated in Cunningham's *Descriptive List*, which, as usual, gives no indication of the localities where they were discovered.

‡ *Indian Antiquary*, Vol. IX, p. 68.

On the slab photographed by Major Cole (Plate 11) Mâyá is shown, standing, facing the spectator, with her head slightly inclined, and the weight of her body thrown on the right foot. Her left leg is crossed in front, with the toes resting lightly on the ground. In her right hand she grasps a branch of the over-shadowing tree, and her left arm is thrown round the neck of her half-sister Prajápatí, who supports her. The figure of the sister is turned in a singularly awkward posture, so as to show most of her back.* The infant Buddha, springing with outstretched arms from his mother's side, is recognizable, though much mutilated; the figure of Brahmá is almost completely destroyed. The other attendants, who are introduced in some examples, are here wanting. A harp in the upper corner of the composition indicates the heavenly music which heralded the advent of him whose mission it was to still the discords of millions of human hearts.

In this work the pose of Mâyá is tolerably graceful, her figure is free from the usual Indian exaggeration, and her expression, in conformity with the belief that the Buddha cost his mother none of the pangs of travail, is perfectly calm. Her hair is richly braided, and arranged in the form of a crown or tiara.

A very finely executed statuette of Mâyá Deví, standing alone, which was obtained at the same monastery, (*Cole, Plate 15, figure 2*), shows her in nearly the same attitude as in the birth scene, holding above her head the branch of a conventional tree, more or less resembling a palm.

The drapery of this figure is specially elegant. The principal garment is a tunic (*chiton*) reaching to the knees, and confined at the waist, by a rich girdle of four strings, adorned with clasp and vine-leaf pendant. A scarf is thrown lightly over the shoulders, and the legs are clad in loosely fitting trousers of thin material. The dress of Mâyá in the nativity group is simpler, and consists of an inner tunic or vest, and a robe wound gracefully round the body, and looped up at the waist.

Single figures like that above described are not uncommon. The slight variations in different examples indicate that they were arranged in pairs.†

Religious artists found in the deathbed of Buddha a subject scarcely less fascinating than the scene of his birth.‡

* See *post*, for a parallel from the Catacombs.

† So, at Cave XX, Ajantá. "Cave XX is a small Vihára with two pillars and two pilasters in front of the verandah. One pillar is broken, but on each side of the capitals there is a pretty statuette of a female under a canopy of foliage." (*Burgess, Notes on the Bauddha Rock-Temples of Ajantá, being No. 9, Archæol. Survey of W. India, Bombay, 1879*). This valuable book is out of print.

‡ The *Descriptive List* mentions only one example of this subject in the Lahore Museum, but the collection there probably includes other specimens. The Indian

According to the Buddhist scriptures, he passed away at the age of eighty, surrounded by his chief disciples, shaded by the *sál* trees in a grove at a place called Kusinagara, which has been fully identified as the modern Kasiá in the Gorakhpur District of the North-Western Provinces.*

All representations of the scene agree in showing the master lying on his right side, in a posture of perfect repose, with his head resting on his hand. The number of attendants varies in different sculptures. Plates Nos. 16 and 22 of Major Cole's volume give illustrations of two well-preserved reliefs, obtained respectively at the upper and lower monasteries of Nuttu, which vividly depict the peaceful departure of the great teacher from this troublous world.

The work from the upper monastery (Plate 16) is a sculptured panel bounded by two good examples of the Indo-Corinthian pilaster.

The dying master, fully robed, reclines on a low bedstead furnished with mattress and pillow, by the side of which a tripod is placed, supporting a vessel of cool water. A figure, identified as Devadatta, the malignant cousin, who had pursued Buddha throughout his life with unrelenting hostility, stands at the head of the couch, with an evil expression of satisfied malice.†

A form, apparently that of a female, with her back to the spectator, sits crouching on the ground, and six mourning attendants in various attitudes complete the group. Above the whole hang the boughs of the *sál* tree, the forest king which witnessed alike the advent and departure of the teacher.

The work from the lower Nuttu monastery, reproduced in Plate No. 22, represents the same scene, though with considerable variation in the treatment of details. In this group the total number of figures is increased to thirteen, the most remarkable addition being that of a shaven-headed monk, crawling on hands and feet, and being pulled from under the bed by another monk, who has grasped him by the wrist.

Museum, Calcutta, contains at least one (G. 27). In later Buddhist art, as seen at Kasiá and elsewhere, the subject was frequently treated. The death-bed scene has often been incorrectly referred to as the Nirvāṇa of Buddha, but the term *parinirvāṇa* may be correctly applied to it.

* Cunningham, *Archæol. Rep.*, Vol. I, pp. 76—85; XVIII, p. 55.

† The figure is that of a man holding a dumb-bell-shaped object, like a club or conventional thunderbolt, and this figure in other reliefs, for example, in that representing the scene of the elephant doing homage, must certainly be identified as Devadatta. But the appearance of Devadatta at the death-bed of Buddha appears to be inconsistent with the legend referred to in Fa-hian's Travels, which relates that Devadatta attempted to poison Gautama, and having failed to accomplish the crime, "went down to hell."

Both the compositions above described are admirably balanced, and the attitudes and expressions of all the persons concerned are rendered with vigour and truth to nature. The drapery, as usual, is Greek, or Græco-Roman, in style.

The design of these death-bed scenes is certainly an importation from the west. The recumbent figure, on the bed surrounded by mourning attendants is clearly copied from Greek banqueting reliefs of a sepulchral character, as imitated on Roman sarcophagi. A sculpture in the Towneley collection in the British Museum bears a very close resemblance to the reliefs from the Nuttu manastery above described.* I have no doubt that the Gándhára sculptures were copied from Græco-Roman, and not pure Greek, models.

The figure of the founder of their religion was the decorative element most largely used by the Buddhist artists in all their works, with the exception of the earliest buildings in Bihár, Central, and Western India, where symbols occupy the place afterwards taken by images. In the countries on the north-west frontier of India, the image of the personal Buddha had become an object of worship at least as early as the latter part of the first century A. D., when it was stamped on coins of Kanishka.†

There is, therefore, no reason to be surprised at the fact that hundreds of sculptures from Gándhára, in various sizes, represent the seated or standing Buddha, posed in one or other of the conventional attitudes (*mudrá*), either buried in meditation, or engaged in exhortation. Such figures are often executed in large numbers on the face of a single slab. Multitudes of specimens present the founder of Buddhism engaged with other persons in one or other incident of his ministry or the preparation for it.

A deeply-cut relief, found at the village of Mohammad Nari, and reproduced in the first plate of Major Cole's book, is a good illustration of the oft-repeated figure of the teaching Buddha, who is here shown seated cross-legged on an open lotus-flower, with his feet draped in a gracefully disposed robe. His right shoulder is bare, and his hair is arranged in formal conventional curls, a style which in later times became the only orthodox arrangement for the hair both of Buddhist and Jain statues.

* *Engravings from the ancient marbles in the British Museum, Part V, Plate III, fig. 5, London. 1826*). In this work the Towneley relief is described as being of Roman origin, but it may be Greek. Prof. Gardner informs me that the Greek works of this class are referred to the period extending from B. C. 300 to A. D. 1.

† Gardner, *Catalogue of Coins of Greek and Scythic Kings of Bactria and India*, pp. 130, 133, 175, Pl. XXVI, 8; XXVII, 2; XXXII, 14.

The central image of the composition, the lotus-throned Buddha, occupies a niche formed by a dentilled cornice resting on Indo-Persian pillars. The rest of the slab is occupied by a profusion of "Buddhist railings" and other architectural details, as well as by a multitude of small human figures, which it would be tedious to describe at length.

The bare right shoulder and formal hair might be supposed to suggest a late date, but the style of the architectural ornaments and the fine execution of the work indicate, in my judgment, that it should be referred to the first half of the third century A. D. I have already noted that this slab is adorned with Indo-Corinthian pilasters, as well as Indo-Persian pillars.

One of the most elegant images of the standing, preaching Buddha is the small statuette from the Mián Khán monastery depicted in figure 3 of Major Cole's Plate 27. The expression of the face is sweet and calm, and the drapery is rendered in the best style. Both shoulders are covered, and the hair, coiled in a top-knot, is artistically and truthfully sculptured. This work seems to me to be of earlier date than the Mohammad Nari specimen, and is probably not later than A. D. 200.

The fine sculpture from the upper monastery at Nuttu (Cole, Plate 12) shows Buddha, wearing moustaches, and with both shoulders covered, seated cross-legged on a low stool under a *sál* tree, addressing a company of adoring disciples of both sexes.

The balanced grouping of this composition is as skilful as that of the death-bed scenes.

The three sculptures above described belong to the best period of the Gándhára school of art.

A statuette of the seated Buddha, about 13 inches in height, executed in blue slate, is shown in Plate IX, fig. 2, and is an example of the school in its decadence. A similar statuette was obtained at Ránígat,* and is fairly good work, though not of the best style.

Another statuette of the seated Buddha, found at Sháh kí dherí, the ancient Taxila by Mr. L. White King, seems to be of comparatively late date, having a Hindú, rather than a Buddhist appearance.

* The great fortress of Ránígat, (also known by the names of Nográm, or Navagrám, and Bágrám), is situated sixteen miles north of Ohind, and just beyond the British frontier. Tribal feuds render the place difficult of access, and, when Mr. King visited it, he required the protection of a strong escort. The ruins have, consequently, never been thoroughly explored. Sir A. Cunningham gives weighty reasons for identifying the site with Aornos, the stronghold which resisted Alexander. The surface of the various courtyards is covered with fragments of "statues of all sizes, and in all positions." (*Archæol. Rep.*, Vol. II, pp. 96—111; V, p. 55). Major Cole in his Second Report notes the existence of seven topes or stupas within the limits of the fortress, and gives a rough plan on a very small scale.

The foregoing descriptions prove that during the most flourishing period of Gándhára art, which I assign to the years between A. D. 200 and 350, the conventional representation of Buddha had not been finally determined, and that it was legitimate to make his image either with or without moustaches, and with the right shoulder either bare or draped. The figure of Buddha on the Amarávati slab No. 11 exhibited on the British Museum staircase has both shoulders draped, but in Buddhist art, as a rule, the founder of the religion is represented with the right shoulder uncovered, and without moustaches.

It has also been shown that the artists of Gándhára were at liberty to give Buddha either the formally curled hair, which in later times, became an indispensable attribute, or to carve his hair artistically in accordance with nature.

The treatment of the hair both of Buddha and other personages in most of the good sculptures from Gándhára is so artistic, and so far superior to the feeble conventionalism of ordinary Indian art, that it may be well to dwell on the subject for a moment.

I agree with Dr. Anderson, in the opinion expressed by him that the woolly hair like that of a negro, arranged in stiff, formal, little curls which is characteristic of the Jain images executed in the tenth and subsequent centuries, and of many Buddhist statues of earlier date, does not indicate, as has been supposed, any racial peculiarity of the Jain and Buddhist saints, but is purely conventional.

Dr. Anderson suggests that this mode of representing the hair is merely an archaistic survival, and that "the hair of the Blessed One having once been carved in this depraved fashion, it was slavishly followed after, with a few exceptions, among which were the sculptors of Gándhára."*

The exact origin of this archaistic treatment of the hair does not at present appear to be traceable, but, whether it be ever discovered or not, it is probable that the explanation suggested above, is, in general terms, the correct one, and that there is no occasion for holding with Mr. Fergusson, that "it has ever been one of the puzzles of Buddhism that the founder of the religion should always have been represented in sculpture with woolly hair like that of a negro."†

As a matter of fact he is not always so represented, nor is the woolly hair peculiar to his images. The puzzle, if it be a puzzle, is one in the history of art, not in the history of religion.

The archaic 'wiry' style of representing the hair was maintained

* Anderson's *Catalogue*, Part I, p. 259. Cf. *ibid.*, p. 175; and *Indian Antiquary*, Vol. IX, p. 116.

† *Tree and Serpent Worship*, 2nd ed., p. 135.

by Greek artists in bronze longer than in marble,* and this observation may possibly serve as the explanation of the woolly-haired Buddhas, which may be conjectured to have been derived from a bronze prototype.

I cannot venture on trying the patience of my readers by describing even a few of the many friezes and panels which vividly present incidents of Buddha's life and preaching, such as his visits to ascetics and Nága kings, and his miraculous escapes from the snares laid by Devadatta. The compositions are like most Roman work, generally crowded with figures, which it would be tedious to describe in detail. Good illustrations of several are given in Major Cole's Plates.

A blue slate panel, about 13 inches in height, representing in high relief a *chaitya* front filled with small figures of Buddha and worshippers, the original of which is in the Lahore Museum, a cast being in Calcutta, is reproduced in Plate IX, fig. 3, and is a fair example of a very numerous class of works.

The sculptors of Gándhára were not restricted in their choice of religious subjects to the birth, death, meditation, miracles, and preaching of Gautama.

At the time when they flourished, Buddhist literature had attained vast dimensions, and offered, in the collections of *Játakas*, or Birth-stories relating to the adventures of the Buddha in his previous births, an inexhaustible treasury of subjects for the art of the painter and the sculptor.

That subjects of this class frequently formed the theme of the Græco-Buddhist artists can be perceived from the mutilated extant fragments of their compositions, though the brittleness of the stone in which their works were generally executed is such that few of the innumerable friezes which decorated the buildings of Gándhára have been preserved in a condition sufficiently perfect to permit of their story being clearly read.

The best preserved connected series of story-telling sculptures is that which adorned the risers of the sixteen steps leading to the central *stúpa* of the monastery at Jamálgarhí, excavated by Lieut. Crompton and Sir A. Cunningham.†

* Perry, *Greek and Roman Sculpture*, p. 351.

† Lieutenant Crompton's report has not, so far as I am aware, been printed in full. Its substance is given in the *Indian Antiquary*, Vol. III, p. 143. The friezes of the risers are the only sculptures found in their original position at Jamálgarhí. All the others had been thrown down, and "in many cases large and heavy fragments of the same sculpture were found far apart." Lieut. Crompton hence concluded that the buildings had been "destroyed by design, and not by natural decay." Sir A. Cunningham's catalogue of the sculptures of the risers arranged in the order of the steps is given in *Archæol. Rep.*, Vol. V, p. 109.

These reliefs excited the warm admiration of Mr. Fergusson, and are certainly deserving of high praise.* Unfortunately they are far from complete. The surviving portions, however, are of considerable extent, and are available for study in Cases 1—3 of the Asiatic Saloon in the British Museum. The arrangement in the museum is arbitrary, and determined rather by the dimensions of the cases than by the order of the steps, or the subject of the sculptures.

When first discovered the series was more nearly perfect, and the discoverer was able to recognize two *Jātakas* or Birth-stories, the *Wesantara* and the *Sāma*.

The latter may be read pretty clearly from the remains in the British Museum (Cases 1—3, tier No. 4). The recognizable scenes are briefly described by Sir A. Cunningham as follows:—

“1.—The young lad, son of blind parents, filling a vessel with water from a lake frequented by deer.

2.—The youth, shot accidentally by the Rājā of Benares, who aimed at the deer, is lying on the ground with an arrow sticking in his side.

3.—The Rājā in a pensive attitude, his head resting on his hand, promises to take care of the lad's parents.

4.—The Rājā presents a vessel of water to the blind parents.

5.—The Rājā leads the two blind people by the hand to the spot where their child's body is lying.

6.—The youth restored to life.”

This story occupied the eighth step of the staircase. The *Wesantara Jātaka*, which adorned the fourth step, is exhibited on the fifth tier from the top of the British Museum arrangement.

The extremely small scale of these sculptures, which are only about eight inches high, interferes with the correct proportional rendering of the several parts. The trees, for instance, are altogether out of scale. But, when allowance is made for this defect, which is unavoidable in the execution of complicated designs crowded into a space so limited, these reliefs may rightly be held to deserve much praise for their vigour of execution, and for their realistic fidelity to nature.

An exhaustive description of the various scenes and multitudinous figures in the *alti-relievi* of the Jamālghāh staircase would task too severely the patience of the most conscientious reader, but a brief discussion of some of their more interesting features may not be unwelcome.

The uppermost tier in the museum arrangement comprises ten small panels, divided one from the other by broad Corinthian pilasters.

* *History of Indian and Eastern Architecture*, p. 173.

Six of those panels, (from the third step of the staircase), are occupied by female busts with the arms raised, and having acanthus leaves extended like wings from the waist on each side. These little figures at once remind the spectator of the angels with which he is familiar in Christian art. It is quite possible that the sculptors of Gándhára may have picked up some hints from artists connected with the churches of Asia Minor and Syria, and I have a suspicion that they did so, though I cannot offer any decisive proof of the supposed fact. I have no doubt that a real connection exists between early Christian art and the Gándhára school. The four remaining panels (from the fifteenth step) contain each a grotesque bust terminating in two scaly tails.

Above these panels nine remarkable Atlantean statuettes are exhibited, which form, apparently, part of a set of twenty-three obtained at Jamálgarhí by Sir A. Cunningham. He supposes that they "filled the spaces between the large dentils which supported the heavy mouldings of the *stúpas*,"* or, as he elsewhere expresses himself, that "they were arranged in rows to support the lowermost moulding of a building. The figures were generally separated by pilasters."†

Numbers of similar figures have been found. Most commonly they are about eight inches high, but they vary in height from four to eighteen inches.‡

The British Museum specimens range in height from about seven to nine inches. All the figures are in a sitting posture, though the attitude varies. One figure crouches like Atlas, as if oppressed under the burden of a heavy load, while the attitudes of the others seem to express repose rather than the endurance of crushing pressure. Some of the faces are bearded, and some are not. The facial expression is freely varied, and rendered with great spirit and vigour. The muscles of the chest and abdomen are fully and truthfully displayed, with a tendency to exaggeration, and a pair of expanded wings is attached to the shoulders of each statuette.

A group of wrestlers (*G.* 82 *Calcutta*), and a composition (*G.* 89 *Calcutta*), catalogued by Sir A. Cunningham as "Herakles fighting with a snake legged giant," both of which were found at Jamálgarhí, are executed in the same style. The latter work (Plate IX, fig. 4) is

* *Archæol. Rep.*, Vol. V, p. 198.

† *Descriptive List*, p. 2.

‡ *Descriptive List*, and *Indian Antiquary*, Vol. III, p. 144. Sixteen statuettes of this class are in the Calcutta Museum (*G.* 81 and 83). A feeble terracotta imitation of the design has been found far away eastward in the Bogra (Bagrahá) District of Lower Bengal. (*Mn.*, 1, in Anderson's *Catalogue*).

thus described by Dr. Anderson in his Catalogue (Part I, p. 240):—"A triangular fragment, with two figures in relief, one lying on the ground with its back towards the spectator, the upper portion being the body of a human being, but the legs terminate from the hips downward in two snake-like coils; the other figure, which is quite nude, has grasped the end of the left coil with his right hand, while with his left hand he has seized the head of the monster, which swings a heavy club to destroy his foe."

I think that it is impossible to doubt that the group last described is a Buddhist adaptation of the Greek myth of the Gigantomachia, the battle of the gods and giants, which continued for centuries to be a favourite subject of Greek and Roman sculptors and gem-engravers. In Greek and Roman art the giants are represented as winged, and snake-legged, and their figures are generally characterized by exaggerated development of the muscles.

No Indian example appears to reproduce exactly the conventional form of the Greek giant, but the characteristics of that form are all found in the Jamálgarhí carvings, though not all combined in a single figure.

The action of the group which Sir A. Cunningham rather rashly entitles "Herakles fighting with a snake-legged giant" is obviously the same as that of the Greek representations of the Gigantomachia, and the very peculiar conception of the snake-legged giant cannot have been independently invented by the Jamálgarhí sculptors. In this case the wings seem to be wanting, but the Atlantean statuettes, which have not the snake legs, are fitted with wings, and display the exaggerated muscular development of the pattern Greek giant. The little figures with tails, from the fifteenth step, appear related rather to the Tritons than the Giants. Their tails seem to be intended rather for those of fishes than to represent snakes.

The Gigantomachia was so frequently the subject of Greek and Roman works of art that it is impossible to name the precise channel by which a knowledge of it reached India. One of the finest examples of the treatment of the subject is the principal frieze of the great altar of Pergamon, the giants of which are winged, snake-legged, and provided with enormously developed muscles.* It is quite possible that the fame of this great composition may have spread through Asia, and stimulated the imitative faculties of a host of minor artists, including those of Gándhára, but the Gigantomachia was such a hackneyed subject that we cannot venture to name any particular example of its

* Casts of the Pergamene frieze are at South Kensington. Engravings of it will be found in many recent books, e. g. Perry's *History of Greek and Roman Sculpture*.

treatment as the model of the miniature, and comparatively feeble, adaptations of it by the Indian sculptors. The influence of Rome on the sculptures at Jamálgarhí, and the other works of the Gándhára school, belonging to the same period, is so strongly marked that the most probable conclusion is that the Indians derived their knowledge of the artistic use of the Gigantomachia from Roman copies of Greek works.

I strongly suspect that the Indians borrowed from the Greeks the giants themselves as well as the sculptured representations of their battles. The Asuras of Hindú post-Vedic mythology are described as fierce demons, enemies of the gods, and correspond closely with the Greek giants. Recent research has proved, or at least rendered probable, the existence of so much Greek, and even Christian, influence on the development of Hindú mythology that the borrowing of the conception of giants, enemies of the gods, offers no improbability.

Whether the Buddhist sculptors of the Kábul valley intended their snake-legged or winged monsters to be images of Asuras, or merely used them as conventional imitative decoration I cannot undertake to determine.

A group, frequently recurring in Gándhára art, of which four examples have been photographed by Major Cole (Plates 1, 2, 4, and 17), and one is in the Woking Museum, can be demonstrated to be an adaptation of a famous composition by a known Greek artist. Another of the ultimate Greek sources from which the sculptors of Gándhára derived their inspiration is thus determined with certainty. I shall discuss this case with some fulness of detail.

The group referred to represents a plump young woman, fully draped, standing, held in the grasp of an eagle with expanded wings, and is reasonably conjectured to represent the translation to heaven of Máyá Deví, the mother of Buddha, in order that she might be born again, as related in the Buddhist scriptures. However this may be, it is quite impossible to doubt the correctness of Sir A. Cunningham's opinion, as quoted by Major Cole, that the composition in question is an adaptation of the Rape of Ganymede, a favourite subject of the later Greek artists, and of their Roman imitators.

The bronze work on this theme by Leóchares (B. C. 372-330) was considered a masterpiece of that famous artist of the later Attic school, and was praised with enthusiasm by Pliny.

The original has unfortunately perished, but several copies or imitations of it, belonging to various periods, some executed in marble, and some engraved on gems, are extant, and have been figured in many well-known works on the history of art.

One of the marble copies is in the British Museum, another is at Thessalonica, a third at Venice, and a fourth, the finest of all, is preserved in the Museo Pio Clementino at the Vatican.*

In this composition, which most nearly corresponds with Pliny's description of the original, the eagle is represented as supported by the trunk of a tree behind it, with its wings expanded, and neck stretched upwards, and grasping firmly, though tenderly, in its talons the beautiful youth, whose feet have just ceased to touch the receding earth. The robe of Ganymede is dexterously disposed behind his back so as to protect his body from the sharp claws of the great bird, and yet to exhibit the full beauty of the nude figure. A dog, seated below, howls piteously for his departing master.

Critics point out that the addition of the dog to this group, and the insertion of the tree, are not only in accordance with the myth as related by Virgil,† but are of artistic importance as an aid to the imagination by rendering more perceptible the soaring movement of the principal figures, and thus minimizing the objections to a plastic presentation of a pictorial subject.

The Buddhist adaptations omit the dog, and in this respect agree with the groups preserved at Venice, Thessalonica, and in the British Museum, but, in the pose of the eagle, and the introduction of the trunk of the tree, they resemble the Vatican group more closely than any other.

Three of the examples of these adaptations figured by Major Cole (Plates 2, 3, and 4) were found in the ruins at Sanghao. His fourth example (Plate 17) was obtained at the upper monastery of Nuttu, which is situated close to Sanghao. The Sanghao specimens figured in Plates 3 and 4 are duplicates, whereas the Nuttu specimen agrees with the Sanghao sculpture illustrated in Plate 2.‡

* Overbeck (*Mythologie der Kunst*) has pointed out that the extant Rape of Ganymede groups fall into two distinct classes. The first represents the eagle as the messenger of Zeus; the second presents the god himself transformed into the shape of an eagle. The Vatican group is the best example of the first and earlier, the Venetian sculpture is the best example of the second and later type. Engravings of the Vatican group will be found in Visconti's *Museo Pio-Clementino*, Vol. III, p. 149, and in the histories of sculpture by Winckelmann, Lübke, and Perry. A figure of the Venetian specimen is given in Zanotti's work on San Marco. The Thessalonican group is described and engraved in Stuart's *Athens*, III, ch. 9, Pl. II and IX. The Indian adaptations seem to combine the characteristics of both types.

† "Puer quem præpes ab Ida

Sublimem pedibus rapuit Jovis armiger uncis;

Longævi palmas nequidquam ad sidera tendunt

Custodes, sævitque canum latratus in auras." (*Æneid*, V, 252-257).

‡ Major Cole says that Sir A. Cunningham found an example of the woman and eagle subject in a knob or plume of a royal statue at Jamálgarhí, which is now

Both the Buddhist variations show a general agreement with one another, though differing considerably in detail. The posture of Mâyá in the specimens figured in Plates 2 and 17 is singularly ungraceful and constrained. As some compensation for this defect her feet are so treated as to suggest the notion that she is really being lifted from the ground, and in this respect these examples are superior to the other two, which altogether fail to convey the idea of upward motion. In both varieties the female figure is fully draped.

The substitution of a fat, round-checked, young Indian woman, swathed in heavy drapery, for the nude form of Ganymede instinct with the beauty of Greek youth, destroys all the æsthetic value of the composition, which is, in its Buddhist forms, devoid of life or elegance, and far inferior to the worst Græco-Roman example. The conversion of a Greek theme to their own uses by the Gándhára sculptors is more readily demonstrated in the case of the Rape of Ganymede than in any other, but, unfortunately for their reputation, they were less successful in dealing with this subject than almost any other which they attempted. Probably it would be correct to say that a purely ideal subject was beyond their powers.

A very curious panel in the Lahore Museum, of which a cast is exhibited at South Kensington, has been differently interpreted by Sir A. Cunningham and Dr. Leitner.

The former describes it as a "portion of a large sculpture, containing eleven figures. The three lower ones are soldiers armed with spears and shields; but the rest, with their animal's heads, large mouths, and sharp teeth, are probably intended for demons. As such they may have formed part of the army which Mára brought to frighten Buddha during his ascetic meditation under the Bodhi tree." (*Descriptive List*, 538.)

The three soldiers in the lower compartment, marching one behind the other, are certainly not Indian in style or equipment. They are Greek, not Roman warriors. Two of them carry long oval shields, the shield of the third differs in shape, having a rectangular body, and circular head, with narrow neck. Sir A. Cunningham's conjecture as to the meaning of the composition fails to explain the presence of these soldiers.

Dr. Leitner, who has seen Buddhist masquerade processions in Ladákh, informs me that he regards the monstrous forms in the upper part of the panel as intended to represent the masks of the Vices in a

in the Calcutta Museum, but the Catalogue does not mention any such specimen. G. 40, a sculpture ten inches high, seems to deal with the same subject, although Dr. Anderson does not recognize it. So large an object can hardly have formed part of a knob or plume.

procession of Vices and Virtues, and that the soldiers may be interpreted as the escort. In his Catalogue he gives a somewhat different explanation.

Whatever be the correct interpretation of this strange composition, it is certainly one of the best, and presumably among the earliest, works of the Gándhára school. All the figures are well executed, and the aged and monstrous heads in the upper compartment are carved with great cleverness and spirit. It probably, like the Athéné, belongs to the pre-Roman period.

Inasmuch as my object in this paper is not the publication of an exhaustive monograph on the Gándhára school of sculpture, but the presentation of a general view of the modes of Græco-Roman influence on India, though with special reference to the Gándhára sculptures, I shall not proceed further in the detailed description of works from the Kábul valley, which deal with subjects obviously belonging to the domain of Buddhist mythology.

Certain decorative elements, which are not peculiar to the Gándhára school, but also occur in the earlier sculptures at Bhárhut and Buddha Gayá in the interior of India, are mythological, but not in themselves, so far as appears, specially connected with Buddhist mythology. I allude to the hippocamps, centaurs, tritons, and various winged and other monsters, which are frequently met with. These forms, which are certainly of Græco-Roman origin, so far as India is concerned, were probably used by the Buddhist artists for purely decorative purposes, without any definite symbolical meaning. Such monsters were common in Greek art, and are supposed especially to characterize the works of the followers of Scopas.

The comic friezes in which boys are shown pulling cattle by the tails, riding on lions, and disporting themselves in sundry fantastic ways, are obviously not Indian in design. Major Cole's plate 26 illustrates a tolerably good specimen from the Mián Khán monastery of such a comic frieze, the figures in which are boys mounted on lions.

The direct model for these works was probably found in Roman art. Their ultimate source is to be traced to the Alexandrian compositions depicting the "*erotopægnia* (love-sports, amatory poems) of the Anacreontic school, in which Eros becomes a boy, and rides all sorts of wild animals and monsters, lions, panthers, boars, centaurs, hippocamps, dolphins, dogs, and deer."*

Among the remains of the Gándhára sculptor's work an extraordinary abundance of detached human heads, chiefly executed in stucco, is met with.

* Perry, *History of Greek and Roman Sculpture*, p. 629.

The cases in the British Museum contain a series of about forty such heads, varying from life-size to very small dimensions. Most of these were obtained in the Pesháwar District, and purchased in 1861 through the late Mr. Thomas.* They are as varied in character as in size, and comprise old and young, male and female, serious and comic. Almost all are good, but I was particularly struck by the head, five or six inches in height, of an aged, emaciated, and bearded man, and the very remarkable life-size head of a laughing youth, with large straight nose, big projecting ears, and a curl of hair on his forehead.

Dr. Leitner has a considerable number of similar heads in his collection, and, as he observes, it is impossible not to notice the resemblance between them and the heads found in Cyprus, specimens of which may be seen in the British, South Kensington, and Woking Museums.

The specimens from the Pesháwar District, in the Indian Museum, Calcutta, marked P 1--18, are similar, and some particularly good examples of such heads, found in the Mián Khán monastery, are figured in Major Cole's Plate 28.

Two plaster heads of this class are figured in plate IX, fig. 5, *a* and *b*. They are about each six inches in height. The head reproduced in fig. *a* is very Greek in feature, though Indian in ornament. The photograph, in consequence of foreshortening, does not do the face full justice.

The great abundance of such detached stucco heads is probably to be explained, at least in part, by the following observation of Masson, who notes that at the village of Hidda, near Jalálábád in the upper Kábul valley, "idols in great numbers are to be found. They are small, of one and the same kind, about six or eight inches in height, and consist of a strong cast head fixed on a body of earth, whence the heads only can be brought away. They are seated and clothed in folds of drapery, and the hair is woven into rows of curls. The bodies are sometimes painted with red lead, and rarely covered with leaf-gold; they appear to have been interred in apartments, of which fragments are also found."†

Section IV. HELLENISTIC SCULPTURE IN INDIA PROPER.

An exhaustive examination of all the known remains of early Buddhist sculpture which exhibit traces, more or less distinct, of teaching derived from Greek sources would, I fear, be extremely tedious,

* Information kindly supplied by A. Franks, Esq., F. R. S.

† *Ariana Antiqua*, p. 113.

and would certainly extend this paper far beyond the limits to which I desire to confine it. The Hellenistic influence on India Proper was slight, and no site in the interior of India contains the remains of a distinct, well-established Greek, or Græco-Roman, school of art, such as existed in Gándhára. I shall, therefore, content myself with a mere passing reference to most of the Indian cases in which the marks of western art teaching have been detected, and shall describe in detail only a few specially interesting works.

The honeysuckle ornament on the capitals of some of the monoliths of Aśoka (B. C. 250) is the earliest example of a Greek form of decoration applied to Indian work. Mr. Fergusson has suggested that Aśoka borrowed this ornament direct from its Assyrian or Babylonian birth-place, and not from the Greeks,* but, considering the fact that, even in Aśoka's time, Assyrian and Babylonian art belonged to a distant past, it seems much more natural to suppose that the Ionic honeysuckle ornament was introduced into India from the Greek kingdoms of Asia with which Aśoka was in communication.

I have already alluded to the tritons, hippocamps, and other marine monsters which formed part of the ordinary Greek decorative stock-in-trade, and passed into Indian art.

The centaur, another characteristic Greek form, is found among the sculptures at Bhárhut, dating from about B. C. 150, and among those at Buddha Gayá, which are somewhat earlier.†

The chariot of the sun, in Indian mythology, is drawn by seven steeds. At Buddha Gayá in Bihár, and again at Bhájá in the Bombay Presidency, we find it represented drawn by four steeds, as in Greek art.‡ Mr. Fergusson also draws attention to the Greek look of "the figure of the spear-bearer" in the Bhájá cave temple.§ The same writer detects the presence of a distinctly Greek element in the well-known sculptures of Amarávati on the Krishna river, and such an element may certainly be traced in them, though its presence is not very obvious on casual inspection.||

* *Cave Temples*, p. 521.

† For a full descriptive account of the sculptures at Bhárhut, see Sir A. Cunningham's special work on the subject. Centaurs at Buddha Gayá and Bhárhut are described in Anderson's *Catalogue*, Part I, p. 129, where further references are given.

‡ For the Buddha Gayá sun chariot, see Cunningham, *Archæol. Rep.*, Vol. III, p. 97; *Buddha Gayá* by Rájendralál Mitra, Plate L; Fergusson and Burgess, *Cave Temples*, p. 521. For the Bhájá example of the same design see *Archæol. Survey of W. India*, Vol. IV, p. 5, Pl. VI.

§ *Cave Temples*, p. 521, Pl. XCVI, 5.

|| See *Tree and Serpent Worship*, 2nd ed., pp. 106, 172.

The most distinct and conspicuous remains of Indo-Hellenic art in the interior of India are those which have been discovered at the ancient city of Mathurá, situated on the Jamuná about thirty-five miles from Agra.

A group in sandstone, found at or near Mathurá, was described and figured more than fifty years ago by James Prinsep as representing Silenus with his attendants, and a second corresponding, though not identical, group has since been discovered by Mr. Growse in the neighbourhood of the same city.

The block first found is three feet broad, and three feet eight inches high, hollowed on the top into a shallow basin, perfectly smooth, and originally nearly circular, and is sculptured back and front with figures in high relief.

"In the front group the principal figure is a stout, half-naked man, resting on a low seat, with wig or vine-crowned brow, out-stretched arms, which appear to be supported by the figures, male and female, standing one on each side. The dress of the female is certainly not Indian, and is almost as certainly Greek. * * * Prinsep agrees with Stacey in considering the principal figure to be Silenus:—'His portly carcass, drunken lassitude, and vine-wreathed forehead, stamp the individual, while the drapery of his attendants pronounce them at least to be foreign to India, whatever may be thought of Silenus' own costume, which is certainly highly orthodox and Brahmanical. If the sculptor were a Greek, his taste had been somewhat tainted by the Indian beau-ideal of female beauty. In other respects his proportions and attitudes are good; nay, superior to any specimen of pure Hindu sculpture we possess; and, considering the object of the group, to support a sacrificial vase (probably of the juice of the grape), it is excellent.' " *

Prinsep's account of the purpose of the block described by him, and his interpretation of the sculptures have both been disputed. I shall not enter into the controversy on the subject, which may be read in the works cited in the note. Personally, I am of opinion, that the drunken man is an Indian adaptation of Silenus.

A third work, much in the same style, and still more obviously

* Cunningham, *Archæol. Rep.*, Vol. I, p. 243. Prinsep's original account will be found in *Journal As. Soc. of Bengal*, Vol. V, (1836), pp. 517, 567, Pl. XXXI. The sculpture described by Prinsep and its subsequently discovered companions are discussed by Mr. Growse, and illustrated by good plates, in the same *Journal*, Vol. XLIV, Part I (1875), p. 212, Pls. XII, XIII, and are further commented on by the same writer in *Mathurá, & District Memoir*. See also Anderson's *Catalogue*, Part I, pp. 170—176.

Greek in subject and treatment, was discovered in 1882 by Sir A. Cunningham, also at Mathurá, where it served an humble purpose as the side of a cattle-trough. This unique specimen now adorns the Indian Museum, Calcutta. Dr. Anderson's careful, though rather awkwardly worded, description of it is as follows:—

"M. 17.—A figure of Hercules, in alto-rilievo, 2 feet 5 inches high, strangling the Nemean lion. The latter is represented standing erect on its hind feet, but grasped round the neck by the left arm of Hercules, who is pressing the neck against his shoulder. The right arm of the statuette is broken off, but, as the axilla is exposed, the arm had been represented raised and bent on itself at the elbow, so that the hand had been brought down close to the shoulder, but hidden in the foliage behind the figure, the tree being the same as occurs in the Silenus group. The greater portion of the knotted club is seen behind the right side of the figure. The action, therefore, is not only that of strangling, but of clubbing the lion as well. The head of Hercules has been lost, and the front part also of the head of the lion. He (*viz.* Hercules) is represented as having worn the skin of an animal over his back, as the front limbs are tied before his chest in a loop-knot, the free ends being the paws. The beard of the lion is indicated by parallel pendants, and, on the full rounded left cheek, there is a somewhat stellate figure with wavy arms, probably a rude Swastika. The fore-limbs of the lion are raised to the front of its neck, grasping the left hand of Hercules, but they are very feebly executed. The general art characters of the figure are essentially Grecian, but, in the attitude in which Hercules is placed towards the lion, and the consequent position of his right arm, it would be extremely difficult to deal any but the most feeble blow. Although there is considerable anatomical accuracy in delineating the position of the various muscles brought into play in Hercules, the lion is devoid of action and badly shaped."*

These Mathurá sculptures have very little in common with those of Gándhára, and seem to be the work of a different school. They have not the Roman impress which is so plainly stamped on the art of Gándhára, and are apparently the result of Greek teaching conveyed through other than Roman channels. It is difficult to fix their date with precision. It cannot well be later than A. D. 300, and the style is not good enough to justify the suggestion of a very early date. Perhaps A. D. 200 may be taken as an approximate date for these works, but at present their chronological position cannot be definitely determined.

* *Catalogue*, Part I, p. 190.

They are by no means, in my opinion, equal in merit to the best of the Gándhára Indo-Roman sculptures, which I assign to the third century A. D.

The Mathurá group of Herakles and the lion may be contrasted with the widely different representation of the same subject recently found at Quetta in Balúchistán. A much corroded copper or bronzo statuette, two and a quarter feet high, discovered at that place, shows the hero standing, and holding under his left arm either the skin or dead body of the slain lion, the right arm being wanting.* This work, to judge from the published plate, has an archaic look, and bears a curiously close resemblance to the colossal figure found at Khōrsábád in Assyria, fancifully named Nimrod by Bonomi, and designated the Assyrian Hercules by other writers. "He is represented strangling a young lion, which he presses against his chest with his left arm, while he is clutching in his hand the fore-paw of the animal, which seems convulsed in the agony of his grasp. In his right hand he holds an instrument which we infer to be analogous to the boomerang of the Australians," etc.†

I cannot venture to assign even an approximate date for the Quetta statuette, and can only say that it is certainly an early work.

Section V. THE CHRONOLOGY AND AFFINITIES OF THE GÁNDHÁRA OR PESHÁWAR SCHOOL OF SCULPTURE.

It is impossible to determine the affinities of a school of art until its chronological position is known at least with approximate accuracy. Apparent resemblances between the works of different schools are apt to be delusive and misleading unless checked by chronological dates independent of the idiosyncrasies of the critic. On the other hand, the style of the works of art, the date of which is in question, is in itself, when used with due caution, an essential element for the determination of the chronology, if conclusive external proof is not forthcoming. In the case of the Gándhára school its chronology and affinities are both still to a large extent undetermined. I shall quote subsequently the divergent judgments of the principal authorities on the subject. For the present I shall confine myself to the examination of the external evidence for the chronology of the Gándhára sculptures. This evidence falls chiefly under three heads, namely, (1) Epigraphic, (2) Numismatic, and (3) the records of the Chinese pilgrims. The pilgrims' testimony, supplemented

* *Journal As. Soc. of Bengal*, Vol. LVI, p. 163, Pl. X.

† Bonomi, *Nineveh and its Palaces*, 2nd ed., p. 163, Plate X.

by scanty historical data from Indian sources, will be more conveniently dealt with in connection with the internal evidence derived from style. The other two heads may here be considered.

The epigraphic material in the Gándhára region is unfortunately meagre in quantity, and the little that exists gives but a small amount of information.

The local inscriptions, known in 1875, are enumerated by Sir A. Cunningham,* and comprise the following records, namely, from

- | | |
|--------------------|--|
| (1.) Jamálgarhí. | (a) Certain mason's marks ;
(β) The Indian names of a weekday and a month on a pilaster ;
(γ) Seven unintelligible letters, read as <i>Saphaë danamukha</i> , incised on the back of the nimbus of one of the statues supposed to be those of kings. |
| (2.) Kharkai. | (a) Masons' marks ;
(β) Three characters, read as <i>a</i> , <i>ra</i> , and <i>de</i> , on the sides of a small stone relic-chamber. |
| (3.) Zeda. | Inscription of Kanishka dated in the year 11. |
| (4.) Ohind. | A fragment dated in the month Chaitra of the year 61. |
| (5.) Takht-i-Bahí. | Inscription dated in the 26th year of Mahárája Guduphara, in the year 103 of an undetermined era. |
| (6.) Panjtár. | Inscription of a Mahárája of Gushán or Kushán tribe, dated in the year 122. |
| (7.) Saddo. | The Indian name of a month on a rock. |
| (8.) Sahri-Bahlol. | The Indian name of a month on a fragment of pottery. |

Inasmuch as Taxila may be included for the purposes of the history of art in Gándhára, the Taxila inscription of the Satrap Liako Kusulako, dated in the 78th year of the great king Moga, should be added to the above list.

I have lately obtained an inscription on the pedestal of a statuette of Buddha dated in the year 274.

All the inscriptions above referred to are in the alphabet variously designated* as Arian, Ario or Ariano-Páli, or Bactrio-Páli, which is written from right to left, and was employed by Áśoka (B. C. 250) in

* *Archæol. Rep.*, Vol. V, pp. 57—64.

his edict inscription engraved on the rock at Sháhábzágarhí (Kapurda-giri) in the Gándhára country. The use of this alphabet never became general in the interior of India, and certainly died out there altogether at an early date, not much subsequent to the Christian era.

These facts have been utilized by Sir A. Cunningham as an argument for the early date of the Gándhára sculptures, but the argument seems to me devoid of all force. When he wrote his Report the latest known date for an Arian inscription was the year 122, recorded in the Panjtár document, and this date was then believed to refer to the era known by the name of Vikrama, B. C. 57. Sir A. Cunningham, therefore, argued "As no Indian letters have been found on any of them, I conclude that the whole of the sculptures must belong to the two centuries before and after the Christian era, as the Arian characters are known to have fallen into disuse about A. D. 100 or a little later."

No one now believes that the Indo-Scythian era is the same as that of Vikrama, and most archæologists hold, though conclusive proof is still wanting, that the Indo-Scythian inscriptions are dated in the Saka era of A. D. 78. If this correction be applied, Sir A. Cunningham's argument will mean that all the Gándhára sculptures must be prior to A. D. 250.

One premise of this argument has been destroyed by the discovery of an Arian inscription dated 274, equivalent to A. D. 352, if referred to the Saka era. That inscription at the present moment happens to be the latest known, but there is no reason why one still later should not be found. The absence of Indian letters on the Gándhára sculptures simply proves that the Indian alphabet was not used in that part of the country, which fact was known already for an earlier period from the existence of Aśoka's Sháhábzágarhí inscription.

The Arian character never took root in India Proper, and its early total disuse there gives no indication as to the date of its disuse in its original home in the countries on the north-west frontier. I should not be surprised, if an Arian inscription dated as late as A. D. 500 should be discovered in Afghanistan or the Western Panjáb.

The Gándhára sculptures can be proved, on other grounds, to be earlier than A. D. 500, up to which date the Arian character may well have continued in use in the country where they occur. The fact, therefore, that the Gándhára inscriptions are all in the Arian character, does not help in any way to fix the date of the sculptures, much less does it prove that they are earlier either than A. D. 100 or A. D. 250.

Among the inscriptions in Sir A. Cunningham's list those from Zeda, Ohind, Takht-i-Bahí, Panjtár, Saddo, and Sahri-Bahlol, are not closely associated with Græco-Buddhist sculptures. The valueless Saddo

fragment inscribed on a rock is the only one among these records found in its original position. These inscriptions consequently give no warrant for the assumption that the Græco-Buddhist sculptures are contemporary with Kanishka or Gondophares, who are mentioned in some of the documents.

The Arian inscriptions at Kharkai and Jamálgraphí are incised on works of the Græco-Buddhist or Gándhára school, but are too fragmentary to be of any use. Sir A. Cunningham wishes to read the characters *a, ra, de*, on the Kharkai relic-chamber as *Arya Deva*, the name of a Buddhist patriarch who flourished late in the first century A. D., but this interpretation is purely conjectural, and cannot be admitted.

The result of all the foregoing discussion is the negative conclusion that, with the exception of the image of Buddha dated 274, no epigraphic evidence to prove the date of the Gándhára sculptures has yet been discovered.

This unique dated inscription is of sufficient interest to deserve a particular description. I am indebted to the kindness of Mr. L. White King, B. C. S., for permission to publish it.*

In or about the year 1883, at Hashtnagar, the site of the ancient Pushkalávati (Peukeloaitis), Mr. King came across a statue of the standing Buddha, which was ignorantly worshipped by the Hindús as an orthodox deity. He could not carry away the statue, but was allowed to remove its inscribed pedestal, a photograph of which is reproduced in Plate X.

The pedestal, like most of the Gándhára sculptures, is composed of blue slate, and is $14\frac{3}{4}$ " long by 8" high. Its front is adorned by an alto-relievo, enclosed between two Indo-Corinthian pilasters, and representing Buddha seated, attended by disciples, who seem to be presenting offerings to him.

An Arian inscription, consisting of a single line of character, deeply and clearly cut, and in great part excellently preserved, occupies a smooth band below the relief. This band was evidently prepared for the inscription, which must have been executed at the same time as the sculpture. The record is incomplete at the end, and the lost portion, which is of very small extent, may have contained the name of the person who dedicated the image.

The extant portion was read by Sir A. Cunningham, for Mr. King, as follows:—

* I have already printed a brief notice of this inscription, accompanied by a lithograph taken from a rubbing, in *Indian Antiquary*, Vol. XVIII, (1889), p. 257. The photograph is now published for the first time.

"*Sam 274 emborāsmasa masasa mi panchami 5—*" The record, as it stands, consists of a date, and nothing more. The month is stated to be intercalary, but is not further named. The numerals are distinct, and their interpretation seems to be free from doubt. The notation is clumsy, and may be rendered thus in Roman numerals, II C XX XX XX X IV, = 274.

The main question suggested by this very scanty record is that of the identity of the era referred to.

The locality in which the inscription was found suggests that the date might be expressed either in the era of Gondophares, as used in the *Takht-i-Bahí* inscription, or the era of the great king Moga referred to in the Taxila record of Liako Kusulako, or in the era, generally identified with the Saka era, which was employed by Kanishka. These are the only three eras, in which Arian inscriptions from the Gándhāra region are known to be dated, and it is reasonable to assume, in the absence of evidence to the contrary, that the number 274 refers to one or other of these epochs. The initial point of no one of the three has yet been ascertained, and consequently an exact date for the new inscription cannot be fixed in any case. But the approximate beginnings of all three eras can be determined by numismatic evidence, and one of two approximate dates can be selected for the inscription.

The coins indicate that the eras used both by Moga and Gondophares must have their starting points about the middle of the first century B. C., and, so far as appears at present, the two may have been identical. For the purpose of selecting an approximate date for the inscription they may be treated as one, and as equivalent to the era B. C. 57, known to the later ages as the Vikrama Samvat.*

* Assuming that the Mahārāja Guduphara of the *Takht-i-Bahí* inscription is identical with the sovereign whose name is variously given on coins, in the genitive case, as Undopherron, Gondopharon, Gudapharasa, Gudaphanasa, and Gadapharasa, or, in the nominative case, as Undophares; and assuming further that all the coins alluded to were struck by one king, then the numismatic evidence indicates that he flourished in the first half of the first century B. C. (See *Gardner's Catalogue of the Coins of the Greek and Scythic Kings*, pp. XLIV, 103—108, *Plates XXII, XXIII, XXXII*). The year 103 of Gondophares would therefore fall about the middle of the first century A. D., and, for rough approximations, his era may be regarded as identical with that of Vikrama.

Assuming that Moga of the Taxilan inscription is identical with Manēs, who is known from coins, his date must be fixed as about 60 or 70 B. C., which, again, is nearly synchronous with the era of Vikrama (See *Gardner*, pp. XXXIII, XLIX. For the Taxilan inscription see *Cunningham, Archæol. Rep., Vol. II, p. 132, Pl. LIX, and Vol. V, p. 67*).

I must not, of course, be understood to suggest that as a matter of fact either Moga or Gondophares used the era afterwards known as the Vikrama Samvat. I use

If then the Hashtnagar inscription is dated in the era either of Moga or Gondophares its approximate date is $274 - 57 = \text{A. D. 214}$.

Though demonstration that Kanishka used the Saka era is still wanting, there is no doubt that the era of his inscriptions does not differ, at the most, more than about twenty years from the Saka, and for the present purpose the era of Kanishka may be taken as identical with the Saka, A. D. 78. Assuming that this era was used in the Hashtnagar record, its date is A. D. 352. The alternative *approximate* dates, therefore, are A. D. 214 and 352.

The style of the Hashtnagar alto-relievo appears to me to be decidedly inferior to that of most of the Mián Khán, Jamálgarhí, Nuttu, and Sanghao sculptures. The figures in it are not undercut, as they are in the best specimens of Græco-Buddhist art, and the execution, on the whole, is poor. So far as I can judge, the work cannot well be older than the middle of the fourth century.

This dubious conclusion is the only assistance given by epigraphic evidence for determining the problem of the age of the Gándhára sculptures.

The numismatic testimony is nearly as scanty and weak as the epigraphic.

The undisturbed hoard of the coins of Azes buried below the Taxila temple with the Ionic pillars indicates, as argued above (p. 115), that that edifice is to be dated from about the beginning of the Christian era, and this inference is in harmony with the reasoning based on considerations of architectural style. It is, as I have already observed, impossible to decide whether the plaster statues found in the Taxilan temple are contemporary with it or not, for no information concerning their style has been published. The coins of Azes found at Taxila, therefore, give no clue to the chronological position of the Gándhára school of sculpture, excepting a few of the earliest works, especially the Pallas, already discussed (p. 121). The only localities, so far as I can ascertain, where coins have been discovered in close association with remains of Græco-Buddhist, or Romano-Buddhist, sculpture, are Jamálgarhí and Sanghao.

Lieutenant Crompton in his report on excavations at the former site says nothing about coins beyond the unsatisfactory remark that "a few silver and copper coins were turned up;"* but Sir A. Cunningham

the epoch B. C. 57 merely as a short expression for any era which began somewhere about the middle of the first century B. C., and about which more accurate knowledge is wanting. The Arian inscriptions from the Gándhára country have not yet been properly edited, and the published translations are quoted with reserve.

* *Indian Antiquary*, Vol. III, p. 144.

is a little more explicit, and records that, during the progress of the explorations, eight coins are discovered, seven of which bore the name of Bazo Deo, or Vasu Deva.*

Unfortunately no more particular account of these coins has been published. We do not know either the circumstances of their discovery, or their numismatic type, and consequently can draw no positive inference from the fact that they were found. Coins bearing the name of Bazo Deo or Vasu Deva continued to be struck for a long period, but none of them are earlier than about A. D. 150,† and all we can say is that the discovery of Bazo Deo coins at Jamálgarhí is perfectly consistent with the inferences to be drawn from the style of the sculptures found in that locality, even if it be assumed, which is not proved, that the coins are contemporary with the sculptures. The coins, for all that appears to the contrary, may have been struck in the third century.

The only other locality where the discovery of coins can be held to afford evidence for fixing the chronology of Gándhára sculpture is Sanghao. The discovery is reported by Major Cole, a good explorer and photographer, but a bad archæologist, as follows:—

“The site where the sculptures were dug is perched on a steep spur, and was the first excavation done under my superintendence in January, 1883. The building revealed two distinct periods, and consists of a *basement* containing small topes, and of a *superstructure* of plain apartments, built obliquely over the *basement*, apparently without reference to its plan.

“The sculptures were found in the *basement*, and belong to the older period; coins of Kanishka, A. D. 80 to 120, were found in the *superstructure*, and belong to the more modern period.”‡

The Kanishka coins were found along with a brass ring in the so-called ‘treasury,’ § in earthen ware jars embedded in the floors at the corners A and B,” as shown in the plan.¶

The sculptures referred to were sent to the Lahore Museum, and form the subject of Plate II of Major Cole’s volume of heliogravures.

A coin of Gondophares was also found somewhere in the same group of buildings.|| Gondophares reigned about A. D. 30, but the mere fact that a coin of his was found at Jamálgarhí would, at the most, prove

* *Archæol. Rep.*, Vol. V, p. 194. The date assigned to Bazo Deo in this passage is admittedly erroneous.

† Gardner, *Catalogue of Coins of Greek and Scythic Kings*, pp. lii, 159—161 Pl. XXIX.

‡ Cole, *Third Report of the Curator of Ancient Monuments in India*, for the year 1883-84, p. cx.

§ Cole, *Second Report*, for 1882-83, p. cxx, Pl. 3.

|| Cole, *Third Report*, p. cx.

an early occupation of the site. It is no evidence of the date of a particular set of sculptures.

The discovery of coins of Kanishka in the superstructure of the Jamálgarhí monastery, above the basement containing the sculptures, is a much more weighty fact, and undoubtedly seems to warrant Major Cole's inference that the sculptures are earlier than A. D. 100. Nevertheless, I am convinced that the inference is a mistaken one. I fully accept Major Cole's account of what he saw, but it is quite possible that he did not see all that ought to have been observed. He is a strong believer in Sir A. Cunningham's theory of the early date of the Gándhára sculptures, and may, like many other people, have been unconsciously biassed by a prepossession. It is impossible for any one who has not minute local knowledge to check the details of an observation as reported, but, while I cannot pretend to point out the seat of the error, I am fully persuaded that the discovery of the coins in question is not to be explained by the theory that the sculptures photographed are earlier than the reign of Kanishka, but should be interpreted in some other way.

My reasons for thus refusing to accept apparently clear external evidence of date will, I hope, be sufficiently established by the discussion of the internal evidence on which I am about to enter. For the present, it will suffice to say that Major Cole's plate refutes his text. The Sanghao sculptures belong to the same school as those of Nuttu, though they may be a little later, and they bear throughout distinct marks of the influence of Roman art of the third or fourth century. They cannot possibly be anterior to A. D. 100, no matter what coins were found above or below them.

The problem demanding solution may be conveniently stated by placing in juxtaposition and contrast the opinions expressed by the two scholars who have attacked it.

Mr. Fergusson, after giving many reasons, some strong, and some the reverse, for his opinion, came to the conclusion "that, though some of these Gándhára sculptures probably are as early as the first century of the Christian Era, the bulk of them at Jamálgiri, and more especially those at Takht-i-Bahi, are subsequent to the third and fourth [centuries], and that the series extends down to the eighth [century]; till, in fact, the time when Buddhism was obliterated in these countries."*

Sir Alexander Cunningham expresses his views as follows:—

"What I have called the Indo-Græcian style must have been introduced by the Greeks who ruled the country; but the earliest specimens, so far as can be proved, belong to the time of Azes, I saw myself twelve

* *Indian and Eastern Architecture*, p. 182.

coins of Azes exhumed from under the temple of *Maliâr-kî-mora* (Sháh-dheri), from which the Indo-Ionic capitals and bases were extracted.

The Indo-Corinthian examples should be equally old, at least all the fine examples. But the oldest that can be proved, belongs to the time of the Antonines, and is *certainly* older than Constantine."

[Here follow detailed references to the *stúpas* at Mánikyála and elsewhere, and to the use of the Arian alphabet, which has been sufficiently discussed above.]

"I would, therefore, ascribe all the greater works, both of sculpture and architecture, to the *flourishing* period of Kushán sway under Kanishka, Huvishka, and Vasu Deva—, or from 80 to 200 A. D.

Doubtless many *stúpas* were erected after A. D. 200 ; but they were comparatively small, and their decorations rough and coarse."

[Reference is then made to the Sahri Bahlol image, and the Hidda and Baoti Pind topes, which will be discussed subsequently.]

"I notice that none of the sculptured head-dresses show any affinity with Sassanian costume, whereas the coins (Indo-Sassanian) show it unmistakeably, from about the time of Bahráh Gor. From this I infer that the sculptures are older than 400 A. D.

"I believe that the strong Sassanian government from A. D. 230 to 450 formed a very effectual barrier to intercourse between Rome and N.-W. India. Roman gold coins are plentiful down to the time of Severus and Caracalla [A. D. 217]. They then disappear until the time of Justin [A. D. 526], Marcian [A. D. 450], Leo [A. D. 474], and Anastasius." [A. D. 491-518].*

I am not able to agree altogether with either Mr. Fergusson or Sir A. Cunningham, and shall now proceed to state the reasons which seem to me sufficient to justify me in venturing to differ from such eminent authorities.

It will be convenient to attempt in the first place to fix possible limiting dates, and, when that has been done, to determine, so far as may be, the approximate actual dates of the sculptures. The chronological enquiry involves the determination of their aesthetic affinities.

As to the initial date there is practically no dispute. It is impossible to be certain that "the Indo-Grecian style" was really "introduced

* My quotations are from a letter dated 8th January 1889, with which Sir A. Cunningham favoured me in answer to enquiries, and which consequently, express his latest and deliberate opinion on the subject. In the Introduction to Volume V of the Archæological Reports he had long ago expressed the same opinion as to the relation between the Kushán dynasty and the Gándhára sculptures, but the theory which he then held as to the Kushán chronology obliged him to fix the date of the sculptures nearly a century and a half earlier than he now does.

by the Greeks who ruled the country," as Sir A. Cunningham affirms that it must have been, because, with the exception of coins, not a vestige of Bactrian art is known to exist, and we know nothing almost about the Greeks who ruled the country beyond the names of some of them.

But, whoever introduced Greek art into India, so far as our present knowledge extends, the Taxilan Ionic temples are certainly our oldest specimens of Indo-Greek architecture, and the statuette of Athene, in the same posture in which she is shown on the coins of Azes, is our oldest Indo-Greek sculpture from the Gándhára region. Both the temples and statuette must date approximately from the beginning of the Christian era.

It has been shown above (p. 112) that Greek art influenced Indian sculpture and architectural decoration from the time of Asoka B. C. 250, and that more or less distinct traces of its influence may be traced in the interior of India for several centuries afterwards. Greek ideas reached India by at least two routes, namely, overland through Bactria, and by sea through the ports of the western coast.

The Athene and the Taxilan Ionic pillars are, I think, to be classed among the results of this old and long-continued Hellenistic influence.

The bases of the Ionic pillars at Taxila, according to the measurements of their discoverer, correspond exactly with the pure Attic model, as seen in the Erechtheum. "The capitals differ from the usual Greek forms very considerably, and more especially in the extreme height of the abacus. The volutes also differ, but they present the same side views of a baluster, which is common to all the Greek forms of the Ionic order."* In other words, the pillars, though with peculiarities of their own, are Greek, not Roman. The Roman modification of the Ionic order was characterized by corner volutes.

At the beginning of the Christian era Roman art, as will be explained presently, had not affected India, and the fact that the Taxilan Ionic pillars are Greek, not Roman, in style, harmonizes perfectly with the numismatic evidence that they were erected soon after B. C. 30.

So far, then, as the Athene and the Ionic pillars are concerned, it must be admitted that the Gándhára sculptures go back to the beginning of the Christian era, and A. D. 1 may be taken as the anterior limiting date. Nothing older is known in the Gándhára region. I shall endeavour to prove subsequently that nothing else which has been found there is nearly so old.

I shall now try to fix the posterior limiting date, which Mr. Fergus-

* *Archæol. Rep.* Vol. V, p. 71, Pl. XVIII.

son places in the eighth century, and Sir A. Cunningham at the beginning of the fifth.

The extension of the Græco-Buddhist series of sculptures down to the eighth century A. D. by Mr. Fergusson was suggested by the published accounts of the opening of the great tope at Mánikyála many years ago by General Ventura.

The undisturbed deposit which was found in the lower portion of that building included coins of Kanishka and Huvishka, and none later, and is legitimately interpreted as signifying that the structure in its original form cannot be older than A. D. 110, nor much later than A. D. 150.

The upper deposits, about the exact position of which there is some doubt, contained various coins ranging in date from A. D. 632 to about A. D. 730, and undoubtedly show that the top of the building must have been opened in the eighth century, and a deposit then made. But they prove nothing more.

We are altogether ignorant of the circumstances under which these upper deposits were made, and it is very unsafe to build any historical theories on their existence. The great tope at Mánikyála is adorned with Indo-Corinthian pilasters, the existing capitals of which are executed in *kankar*, or nodular limestone. Sir A. Cunningham supposes that all the original work of the tope was in sandstone,* and that the *kankar* mouldings date from the eighth century.* No other example of Indo-Corinthian work of that date is known, and, if the existing capitals were executed in the eighth century, I feel certain that they were mere restorations. As a matter of fact their date is quite uncertain. The attempt to connect the coin of Yaśo Varma, A. D. 730, which was found in the upper deposit, with supposed repairs of the tope in the eighth century is purely conjectural.† All we really know is that somebody for some reason unknown opened the building at the top and put in a coin of Yaśo Varma. Such an adventitious supplementary deposit is no substantial basis for an argument that Buddhism and Indo-Hellenic art still flourished in the Gándhára region in the eighth century, and, except Yaśo Varma's coin, no evidence whatever, so far as I am aware, exists to support the inference that the Gándhára school of art continued to exist so late as the eighth century.

In another place, Mr. Fergusson, still relying on the same poor little coin, has given an unwarrantable extension to the duration

* The great Mánikyála tope is discussed by Cunningham at considerable length in *Archæol Rep.*, Vol. II, p. 139, and Vol. V, pp. 76—78.

† [It is more probable that the coin is of the 6th century, of a Yaśo Varman about 532 A. D. This would admirably fit in with "the limiting date" given on p. 153. See *Proceedings* for August 1888. Ed.]

of Buddhism as a dominant faith in Gándhára. "There were," he writes, "probably no great Buddhist establishments in Gándhára before Kanishka, and as few, if any, after Yáso Varma, yet we learn that between these dates [*i. e.* circa A. D. 78 to 730], this province was as essentially Buddhist as any part of India.*

In support of the last clause of this sentence the Chinese travellers Fa Hian and Hiuen Tsiang are appealed to, but their testimony does not support the conclusion drawn from it. After the middle of the seventh century, when Hiuen Tsiang wrote, very few parts of India were "essentially Buddhist," and Gándhára certainly was not. In A. D. 730 very little Buddhism can have been left in it.

Mr. Fergusson's language is correct when it is confined to the beginning of the fifth century. Fa Hian who travelled in India in the years A. D. 400—405, found Buddhism vigorous and flourishing in Gándhára, as in a large part of India. But, at the time of the travels of Hiuen Tsiang, A. D. 629—642, a very great change had taken place, and Gándhára was very far from being "essentially Buddhist."

The capital city of Gándhára, the modern Pesháwar, is, he notes "about 40 *li* [= 6 to 7 miles] in circuit. The royal family is extinct, and the kingdom is governed by deputies from Kapisa [N. of Kábul]. The town and villages are deserted, and there are but few inhabitants.

At one corner of the royal residence there are about 1,000 families * * * There are about 1,000 *sanghárámas* [monasteries], which are deserted and in ruins. They are filled with wild shrubs, and solitary to the last degree. The *stúpas* are mostly decayed. The heretical temples, to the number of about 100, are occupied pell-mell by heretics."

At Pushkalávati, the modern Hashtnagar, the pilgrim found a large population, but not of the congregation of the faithful, for the Buddhist buildings, like those of the capital, were in ruins.

Taxila, east of the Indus, was dependent on Káshmír, the royal family here also being extinct. The monasteries are described as "ruinous and deserted, and there are very few priests; those that there are, study the Great Vehicle."†

The graphic and emphatic words of Hiuen Tsiang prove with absolute certainty that at the time of his visits (A. D. 629—642) the Buddhist religion in Gándhára was nearly extinct. The utter decay of which he gives such clear testimony must have been in progress for a considerable time. It is not possible that the Buddhist edifices of Pesháwar could have become "deserted and in ruins, filled with wild shrubs, and solitary to the last degree" in a day.

* *History of Indian and Eastern Architecture*, p. 76.

† Beal, *Buddhist Records of the Western World*, Vol. I, pp. 100, 109, 137.

It is quite safe to assume that Buddhism had ceased to be an active force in the Gándhára region, including Taxila, by the year A. D. 600; and it is inconceivable that new religious edifices on any considerable scale should have been erected, or works of art deserving of the name, executed in that region subsequent to that date by the scattered, poverty-stricken, and necessarily dispirited adherents of a decaying religion.

It follows, therefore, that the series of Græco-Buddhist works in Gándhára does not extend, as Mr. Fergusson supposed, to the eighth century, but, on the contrary, was closed by the end of the sixth century.

As a matter of fact, the closing date must, I believe, be pushed back considerably farther, but in any case, *A. D. 600 must be taken as the extreme possible limiting posterior date for any work of the Gándhára school in the Lower Kábul Valley.* The dates of which we are in search lie, therefore, between A. D. 1 and A. D. 600.

The above argument, based on the testimony of Hiuén Tsiang, appears to me unanswerable, but it may be well to supplement it by other arguments, in themselves of less force, which reduce the closing date to still narrower bounds. I have already quoted Sir A. Cunningham's remark that the head dresses of the Gándhára sculptures show no affinity with the Sassanian costume, and that the sculptures may therefore be regarded as prior, not only to A. D. 600, but to A. D. 400.

Another observation of Sir A. Cunningham's leads to nearly the same conclusion. He observes that "all, or nearly all, Buddhist building must have been stopped after the occupation of Pesháwar by Kitolo's son in the latter part of the fifth century." The Chinese account show that "the last king of the Yuchi [Yueh-ti] mentioned in history is Kitolo, who took possession of Gándhára, but was obliged to return to the west to oppose the white Huns, leaving his son in charge of the new province. The son established his capital in Fo-lu-she, or Parsháwár [Pesháwar]; and the name of the founder of the Little Yuchi, as they were afterwards called, still survives in the title of Sháh Kator, the Chief of Chitrál."*

The coins of the kings of the Little Yuchi are described as bearing Saiva emblems,† and the kings themselves, therefore, were presumably Brahmanists. It is going too far to assume with Sir A. Cunningham that the rule of a Saiva king must necessarily have put a stop to all, or nearly all, Buddhist buildings, but it must certainly have been un-

* My first quotation is from a private letter. The second is from *Archæol. Rep.*, Vol. II, p. 63. I have not verified the reference to Chinese authors, which is not given in detail.

† *Archæol. Rep.*, Vol. V, p. 7. I have not seen any of these coins.

favourable to their erection. In another place Sir A. Cunningham speaks of "the first persecution of Buddhism by the Saiva kings of the Little Yuchi,"* but I do not know what evidence exists for this alleged persecution. Whatever may have been the precise attitude of the Little Yuchi kings towards Buddhism, it is certain that the latter years of the fifth century were times of conflict and turmoil throughout Northern India. The Bhitarī pillar inscription records the struggles between the Gupta dynasty and the Huns (Hūnas), and in or about A. D. 480, on the death of Skanda Gupta, the Gupta empire broke up.† A few years later the stormy career of the Hūna chief Mihirakula disturbed the whole of Northern India from Bengal to Kāśhmīr.‡ In such a period of anarchy and confused struggles for dominion the arts of peace are perforce neglected, and it would be strange indeed if Gāndhāra in those days was the scene of the peaceful development of a considerable school of sculpture, as Mr. Fergusson supposed it to have been.

I doubt also if the Græco-Roman impulse retained any considerable force after A. D. 450, even on the north-west frontier. By that time it had certainly spent itself in India Proper, both in the North and West. The last faint traces of Greek skill in design are observable in the Gupta gold coinage of Chandra Gupta II, which was minted in Northern India about A. D. 400,—the later Hindū coinage is all barbarous in style. Corrupt and unmeaning Greek letters linger on the silver coins of Kumāra Gupta and Skanda Gupta struck in Western India up to about A. D. 480, but the fact that these letters are corrupt and unmeaning shows that Hellenistic culture had then dwindled down to a dead tradition, even in Gujarāt, which had been for centuries in communication with Alexandria and Rome.

In short, all that is known of early Indian history indicates the great improbability of the existence of a flourishing Hellenistic school of sculpture on the north-west frontier later than A. D. 450.

Before proceeding to the discussion of the artistic relations of the Gāndhāra sculptures, which will render the chronology more definite, one other piece of external evidence may be cited to prove that the good sculptures are much earlier than A. D. 600.

* *Archæol. Rep.*, Vol V, p. 42.

† [See, however, on the dissolution of the Gupta empire, the paper, '*On an Inscribed seal of Kumāra Gupta*, ante, p. 85. Ed.]

‡ For the history of the Gupta period see Mr. Fleet's work on the Gupta inscriptions, Vol. III. of the *Corpus Inscriptionum Indicarum*. I have given a very brief outline of it in my essay on the Gupta Coinage in the *Journal Royal Asiatic Society* for January 1889, to which reference may be made for the proof of the remarks in the next paragraph.

A statuette, Indo-Greek or Indo-Roman in style, wanting the hands and feet, was discovered by Dr. Bellew in the Gándhára country, carefully enclosed in a sepulchral chamber at the level of the ground in the centre of a *stúpa*. The statuette represents the standing Buddha, and is characterized by Dr. Bellew as "better carved than the generality of figures met with," and by Sir A. Cunningham as "fine."*

The style of the statuette shows that it was executed during the flourishing period of the Gándhára school, and its mutilated condition proves that it was already old when deposited in the *stúpa*. The form of that building indicates that it was created not later than A. D. 600, nor much earlier than A. D. 500.

It is thus evident, remarks Sir A. Cunningham, that the statuette was utilized at a time "when the zeal of first converts had long since died away, and the growing indifference of the people no longer required the manufacture of new statues. Under such circumstances, I can readily suppose that the builders of the tope may have deposited any piece of Buddhist sculpture that came to hand, just as Bráhmans at the present day will set up and worship any statue which may be found, caring little for its state of mutilation, and still less for its possible connexion with Jainism or Buddhism."

This curious discovery thus confirms the evidence already adduced to prove the propositions that the period A. D. 500—600 was one of decay for Buddhism in Gándhára, that few new religious edifices were erected during that period, though their construction did not altogether cease, and that the vigorous, local school of Indo-Hellenic art belongs to an earlier time.

My contention that the history of the Gándhára school of Indo-Hellenic art, consecrated to the service of Buddhism, was practically at an end by A. D. 450, may be met by the observation that Buddhist monuments of later date are known to exist in the upper Kábul Valley and elsewhere in the neighbouring countries.

One of the latest *stúpas*, to which a date at all definite can be assigned, is that known as No. 10, at Hidda near Jalálábád. This building contained a deposit of coins consisting of five gold *solidi* of the Byzantine emperors Theodosius, Marcian and Leo (A. D. 407—474), two very debased imitations of the Indo-Scythian coinage, which may be assigned to the sixth century, and no less than 202 Sassanian coins of various reigns, but all agreeing in the absence of any trace of Muhammadan influence.

Masson and Wilson, arguing from these facts, reasonably came to

* Cunningham, *Descriptive List*, No. 165; and *Archæol. Rep.* Vol. V, p. 42, with quotations from Dr. Bellew's Report on Yúsufzai, the original of which I have not seen.

the conclusion that the *stúpa* must have been constructed between the years A. D. 474 and 690, at which latter date the Muhammadan incursions had begun, and Kábul was governed by Bráhmaṇ kings.*

The Sassanian coins indicate that the monument was erected about A. D. 600.

A *stúpa* belonging to approximately the same period, with an undisturbed deposit of coins, was opened by Sir A. Cunningham at Baoti Pind in the Ráwal-Pindi District, east of the Indus.†

No *stúpa* of later date than those at Hidda and Baoti Pind is, I believe, known either in Afghánistán or the Panjáb, though I should be sorry to affirm that none such exist.

These examples prove, as we had already learned from Hiuen Tsiang, that Buddhism, though sadly weakened at the beginning of the seventh century, was still alive, and show, which was hardly to be expected, that occasionally persons could still be found willing to spend much time and money on works dedicated to the religion of Buddha.

But these examples prove nothing in favour of the late continuance of the Gándhára school of sculpture.

I do not think that any Indo-Hellenic sculpture was found associated with the ruins of the Baoti Pind *stúpa*. The published information concerning the architectural and sculptured decorations of the *stúpas* near Jalálábád is very meagre. So far as it goes, it indicates that, whatever may be the reason of the difference, the monuments in the upper Kábul valley do not display such manifest traces of Græco-Roman influence as do those situate in the lower Kábul valley or Gándhára. Wilson speaks more than once of "plain mouldings" on the pilasters, and does not, I think, note any example of the Indo-Corinthian capital among the ruins of the Jalálábád topes. The date of these topes has, consequently, little bearing on the question concerning the chronology of the Gándhára sculptures.

It is probable that these sculptures are the work of a special local school, working on the lines of Roman art under the patronage of the sovereigns who resided at the city now known as Pesháwar. It seems clear that the head quarters of the school were at Pesháwar, and that the special modification of Roman art, worked out by the artists of that city, never spread beyond the bounds of a comparatively small region in the vicinity of the capital. The connection between the Pesháwar school and the architects and sculptors of interior India was, I believe, very slight, if it existed at all.

I have ventured to assert positively that the Gándhára or Pesháwar

* *Ariana Antiqua*, pp. 44, 110, Pl. XVI, XVIII.

† *Archæol. Rep.*, Vol. II, p. 141.

local school of sculpture followed the lines of Roman art, and is not the direct descendant of pure Greek art. This proposition of course is to be taken strictly as applying only to the Pesháwar school. It does not apply to the case of the Ionic pillars at Taxila, nor to the sculptures at Buddha Gayá or Bhárhut. The Sánchi work too is probably free from Roman influence, and I cannot perceive any very clear traces of such influence at Amarávati, though I am not certain that it is altogether absent. The art work in some of the caves in Western India, on the other hand, was in all probability influenced by the specially Roman developments of Greek art.

I pass by on the present occasion the wider questions suggested by an examination of the entire field of early Indian art, and confine myself to the discussion of the nature and degree of Roman influence on the local Gándhára or Pesháwar school of sculpture, which is specially characterized by the use for decorative purposes of the Indo-Corinthian capital.

A brief outline of some of the most material facts in the history of the intercourse between Rome and India will help my readers to appreciate more accurately the value of comparisons between Indian and Roman works, and to understand the bearing of such comparisons on the chronology of the Gándhára school.

Roman influence was not felt by India until after the establishment of the empire of the Cæsars, and the subjugation of Egypt by Augustus; and even during the reign of Augustus, the maritime commerce between Rome and India appears to have been conducted by Arab ships.

The discovery or re-discovery of the course of the monsoon by Hippalos, about the middle of the first century A. D., first rendered it possible for Roman ships to reach the Indian shores.

The overland trade between India and the Roman empire appears to have first attained large dimensions at about the same time. Pliny, who died A. D. 79, laments, in a well-known and often quoted passage, the heavy drain of gold from the capital towards the east, and his evidence is confirmed by the large number of coins of the early Roman empire which have been found in India.

The overthrow of the Nabatæan kingdom of Petra in A. D. 105 secured for Palymra the commercial preeminence on the principal land route between the Roman empire on one side and India and China on the other, and that city retained the preeminence thus gained until it was sacked by Aurelian in A. D. 273. Palymra was visited by the emperor Hadrian about the year A. D. 130, and about A. D. 200, in the reign either of Septimus Severus, or of his son Caracalla, was made a Roman colony.

Active communication between the Roman empire and the far east was maintained during the third century, not only by the peaceful methods of commerce, but by the frequent oriental expeditions of the emperors. The disastrous war of Valerian with the king of Persia, A. D. 254—260, brought the armies of Rome into almost direct contact with India.

The period of Palmyra's commercial greatness, A. D. 105—273, coincided with the period of Roman military activity in the east, and in part with the prosperity of Alexandria, the emporium of the Indian sea-borne trade. This period, accordingly, is that during which Roman intercourse with India attained its maximum. "It was during the reigns of Severus [A. D. 194—211], his son Caracalla [A. D. 211—217], and the Pseudo-Antonines that Alexandria and Palmyra were most prosperous, and that Roman intercourse with India attained its height. The Roman literature gave more of its attention to Indian matters, and did not, as of old, confine itself to quotations from the historians of Alexander, or the narratives of the Seleucidan ambassadors, but drew its information from other and independent sources."

The existence of such independent sources of information is apparent from the works of Clemens Alexandrinus, (who mentions Buddha and *stûpas*), Philostratus, Ælian, and other writers.*

It so happened that at the date, A. D. 273, of the cruel destruction of Palmyra, Alexandria too had fallen into comparative decay. "It would," of course, as Priaulx observes, "be absurd to suppose that the destruction of Palmyra, however much it affected, put an end to the Indian trade through the Persian Gulf." The trade continued, and part of it passed for a time to Batné near the Euphrates, a day's journey from Edessa.† But the Indo-Roman trade, though not stopped, was necessarily very much diminished in volume by the destruction of its overland, and the decay of its maritime emporium, and the intercourse between Rome and the far east became much more difficult and intermittent than it had been for about two centuries previously.

The Alexandrian trade about this time seems to have been abandoned by Roman ships, and to have depended on Arab vessels, as in the days of Augustus. In the reign of Constantine (A. D. 306—337) commerce with the east revived, but the Roman ships seem to have rarely, if ever, ventured, beyond the Arabian Gulf of the Red Sea.

* Priaulx, *Apollonius of Tyana and Indian Embassies to Rome*, pp. 132, *seqq.* My remarks on the course of Roman trade with India are chiefly drawn from this valuable little book and Prof. Robertson Smith's article on Palmyra, in the ninth edition of the *Encyclopædia Britannica*.

† Priaulx, *Apollonius of Tyana*, etc., pp. 178, 233.

The known facts of the external relations between the Roman empire and India, therefore, apart from all æsthetic criticism, suggest that, if Indian art was influenced by Roman art, the influence would have been most active during the period which may be defined, in round numbers, as extending from A. D. 100 to 350. It would hardly be reasonable to expect that the partial interruption of intercourse between A. D. 273 and 306 should be traceable in Indian art history, and it is not traceable.

I have named A. D. 100 as the approximate earliest possible anterior limit for Roman influence on Indian art, but, as a matter of fact, that date is too early. The name of Rome must of course have been long known to a greater or less extent in India, but I doubt if the Oriental would know much about the Roman empire, before the reign of Hadrian (A. D. 117—138), whose expeditions to Syria (*circa* A. D. 130), and passion for building great edifices must have spread the fame of his power among the merchants of the east. I consider it improbable that Roman models could have affected Indian art before A. D. 150. On the other hand, Roman influence continued to be felt by the arts of India after A. D. 350, and may not have completely disappeared for a century later.

The ground has now been cleared for an examination in some detail of the Roman elements in the art of the Gándhára or Pesháwar school. The general aspect of the figure sculptures and architectural decorations of that school is, as Mr. Fergusson perceived, distinctly Roman, but a vague assertion to that effect cannot convince anybody who has not acquired some familiarity with the art both of Rome and Gándhára. Detailed proofs are necessary to carry conviction to the mind of the ordinary reader. I shall now proceed to give some.

“Roman architecture, as we know it, dates only from about the Christian era, and the rapidity with which it spread from that time is something marvellous. Through nearly the whole extent of the Roman empire, through Asia Minor, Sicily, Britain, France, Syria, Africa,—with one great exception, Egypt,—all was Roman in moulding, ornament, details, the very style of carving, and the construction. No matter what the country of the architect, all seem to have lost their nationality when the Roman came, and to have adopted implicitly his system of design and decoration.....”

“It is not uncommon to find examples of Roman architecture completely overdone with ornament, every moulding carved, and every straight surface, whether vertical or horizontal, sculptured with foliage or characteristic subjects in relief.”*

* Lewis and Street, article Architecture in *Encyclopædia Britannica*, 9th edition, pp. 418, 421.

To the list of countries above enumerated as having adopted the Roman system of design and decoration, the Lower Kábul Valley, though it never formed part of the Roman empire, must be added.

So far as I understand the published plans and elevations, the Gándhára buildings show little Roman influence in their construction, though I should not venture to affirm that careful study might not reveal the existence of Roman elements in their plan and construction. However this may be, these buildings, like those of the provinces of the empire, were "Roman in moulding, ornament, details, and the very style of carving," and were characterized, like better known examples of Roman work, by excess of ornament, and by the lavish use for decorative purposes of crowded realistic compositions in high and low relief.

Almost every frieze or panel from Gándhára is decorated with florid Corinthian pilasters, and numerous fragments of similar Corinthian capitals belonging to structural pillars have been found. No one can give the most cursory glance at a collection of Gándhára sculptures without being struck by the free employment of the Corinthian capital as an ornament. No other Græco-Roman form of capital is used, though for a time the Indo-Persian form continued to dispute the field with its newly introduced rival.

Such extensive and exclusive use of the Corinthian form of pillar is in itself decisive proof that the school characterized by it was dominated by Roman influence, and was not a direct descendant of Greek art.

The case of Palmyra offers an exact parallel to what we see in Gándhára. "It is remarkable," observes Wood, "that, except four Ionic half-columns in the temple of the sun, and two in one of the mausoleums, the whole is Corinthian, richly ornamented, with some striking beauties, and some as visible faults."*

We find the same state of facts at the other great Syrian city of Baalbec, or Heliopolis, "which, so far as it has been known to modern travellers, is a Roman city of the second century A. D. The Corinthian order of architecture—the favourite order of the Romans—prevails with few exceptions in its edifices. A Doric column, the supposed clepsydra, is, indeed, mentioned by Wood and Dawkins, and the Ionic style is found in the interior of the circular temple;" but all else is Corinthian.

The style of the great temples at Palmyra is later and more debased than that of the corresponding edifices at Baalbec. No building of importance was erected at Palmyra after the sack of the city by Aurelian in A. D. 273, and the temples may be referred to the third century A. D.,

* Wood, *Palmyra*, p. 15.

having probably been erected during the reigns of Odænathus and Zenobia (A. D. 260—273.)

During the period A. D. 105—273 Palmyra was the principal depôt of the overland trade between India and the west, and the caravans which were constantly passing and re-passing through it must have affected some exchange of ideas as well as of more material wares. It is, therefore, reasonable to believe that the example of Palmyra was one of the factors which influenced the Gándhára architects and sculptors in their adoption of the universally diffused Corinthian style.*

The peculiarities of the Indo-Corinthian pillars have been briefly described in a previous page (pp. 117, 118).

Sir A. Cunningham holds that "at least all the fine examples" of the Indo-Corinthian style, such as the capitals found at Jamálgarhí, which are the finest known, should be ascribed to the same age as the temples with Ionic pillars at Taxila.

This view appears to me altogether erroneous, and inconsistent with the observed facts. The Taxilan temples date from the beginning of the Christian era, and show no trace of the domination of Roman ideas of art.

The Indo-Corinthian remains, on the other hand, bear on their face the most obvious resemblance to Roman work, and must consequently be later than the time when India and Rome came into contact. On historical grounds I have fixed the approximate date at which Roman forms of architectural decoration reached India as not earlier than A. D. 150, and an examination of the Indo-Corinthian works fully confirms this inference drawn from the known facts of external history.

It is, I venture to affirm, impossible that a florid adaptation of the Corinthian order, such as is universally employed in the buildings of Gándhára Proper, could have attained such favour except under Roman influence.

Pure Greek examples of the Corinthian order are extremely rare, while Roman examples are numbered by thousands. The Corinthian pillar, modified so freely, that no two specimens exactly agree, was the favourite architectural decoration employed by the builders of imperial Rome, and by those of the subject provinces, who followed the fashion set at the seat of government.

I think I am perfectly accurate in asserting that Corinthian capitals, at all like those at Jamálgarhí, were not produced anywhere in the world as early as the beginning of the Christian era, whereas plenty of capitals,

* Prof. Robertson Smith's articles in the *Encyclopædia Britannica*, 9th edition, give excellent summaries of the present state of knowledge respecting Palmyra and Baalbec.

very like these, though differing in detail, were executed in various parts of the Roman world during the third and fourth centuries.

The fact, (according to Sir A. Cunningham's measurements), that the only two Indo-Corinthian bases of columns yet discovered do not differ widely from the bases of the pillars in the Choragic monument of Lysicrates, which was erected in B. C. 334, does not render credible the supposition that capitals similar to Roman work of the Antonine period were executed at the beginning of the Christian era.

Mr. Fergusson described the Jamálgarhí capitals as being "more Greek than Roman in the character of their foliage, but more Roman than Greek in the form of their volutes and general design. Perhaps," he added, "it would be correct to say they are more Byzantine than either, but, till we have detailed drawings, and know more of their surroundings, it is difficult to give a positive opinion as to their age."*

The great critic, with the imperfect materials at his command, might have felt a difficulty in deciding whether a given specimen was to be dated from A. D. 200 or 400, but he had no difficulty in seeing the strong Roman element which exists in all the specimens. Mr. Freeman has more than once called attention to the remarkable circumstance that human figures are inserted among the acanthus foliage of the Corinthian capitals in the ruins of the Baths of Caracalla at Rome.

"The artist," he observes, "has been so far from confining himself to one prescribed pattern, either of volutes or acanthus leaves, that he has ventured to employ vigorously carved human or divine figures as parts of the enrichment of his capitals."†

Similar figures, employed just in the same way, occur in some of the Indo-Corinthian capitals from Jamálgarhí, and are described by their discoverer as follows:—

"The human figures, which are introduced in the spaces between the acanthus leaves, are all small, and do not interfere in the least degree with the treatment of the foliage. When there is only one figure, it is always that of Buddha, either sitting or standing, and, when there are three figures, the middle one is of Buddha, and the others are attendant Arhans. These figures are never obtrusive, and they are always so placed that, to my eye, they harmonize most agreeably with the surrounding and overhanging foliage."‡

* *History of Indian and Eastern Architecture*, p. 174.

† The quotation is copied from Cunningham, *Archæol Rep.*, Vol. V, p. 193, where the original is said to be in an essay by Mr. Freeman published in Macmillan's Magazine; but no exact reference is given. Mr. Freeman alludes briefly to the subject in his separately published essays on Italian architecture.

‡ Cunningham, *Archæol Rep.*, Vol. V, p. 193. On the same page the author makes an unfortunate slip, and places Caracalla "in the beginning of the first century

Whatever be the æsthetic merits or demerits of the practice of introducing human figures into the Corinthian capital, it was a Roman practice. No one will contend that the capitals in the Baths of Caracalla are imitations of those in the Gándhára monasteries. It follows that the Gándhára capitals are imitated either from those in the Baths of Caracalla, or others of similar design of the same period. The reign of Caracalla extended from A. D. 211 to 217; and the necessary inference is that the Jamálgarhí capitals with human figures are later than A. D. 217.

This inference as to the date of the Jamálgarhí sculptures derived from the character of the capitals is in complete accordance with the conclusions deducible from an examination of the style of the sculptures in relief.

Before quitting the topic of the Indo-Corinthian capitals, it is only just that I should complete the account of Mr. Fergusson's views as to their date. He argues that their form argues a date later than the reign of Constantine (A. D. 306—337), after which time "the design of the capitals went wild, if the expression may be used. The practice of springing arches from them, instead of supporting horizontal architraves, required a total change, and in the West it produced exactly the same effects that we find in Gándhára.* The capitals for instance, in the churches of St. Demetrius and that now known as the Eski Jouma of Jouma at Salonica, both built in the early part of the 5th century, are almost identical in design with these, and many of the churches in Asia Minor and Syria show the same 'abandon' in design, through frequently in another direction."

I have no doubt that Mr. Fergusson is right in comparing the Gándhára capitals with those of the two Syrian churches belonging to the early part of the fifth century which he names, and that a general resemblance exists between the objects compared. Such a general resemblance is quite natural, even if there be an interval of fifty or a hundred years between the Syrian and the Indian pillars. But, if Mr. Fergusson intended to suggest that the Jamálgarhí pillars were exe-

of the Christian era," and thence argues for the early date of the sculptures. Mr. Fergusson, in correcting this accidental error, allowed himself to fall into a similar one, and dated the baths of Caracalla in the reign of Constantine.

* *Indian and Eastern Architecture*, p. 178, with references to Texier and Pullan's *Byzantine Architecture*, and De Vogüé's *Syrie Centrale*. The Syrian pillars figured by De Vogüé display certainly a great 'abandon' of design, but they have no resemblance whatever to the Gándhára forms. I except, of course, the comparatively regular Corinthian capitals at Palmyra and Baalbec, which are not much dissimilar from the Gándhára varieties.

outed subsequent to the reign of Constantine, I cannot agree with him. They belong rather to the Antonine period, and may be referred with approximate correctness to A. D. 250, the Indian development being necessarily a little later than its Roman original.

I do not know whether true structural arches, carried on Corinthian pillars, were employed in the construction of the Gándhára monasteries or not, but it is probable that they were; for the reliefs show numerous examples of arches carried on such pillars, and used as decoration.

Mr. Fergusson's hint that it would perhaps be more accurate to call the Indo-Corinthian capitals Byzantine than either Greek or Roman does not seem to me a fruitful one. The term Byzantine may, of course, be used with reference to any Roman art of the fourth century,* to which period some of the Gándhára sculptures must be referred, but it generally connotes the formal, hieratic, and long stationary style of later date. The good Gándhára works do not seem to me to be characterized by the hieratic stiffness which is the special note of Byzantine art, although some of them are closely related to works executed in the reign of Constantine; and when the school began to decay, the art of Gándhára passed, not into Byzantine formalism, but into Hindú barbarism.

When Mr. Fergusson wrote, the erroneous date which he assumed for the Amarávati rails, and the inferences which he drew from the discovery of the coin of Yaśo Varman in the great tope at Mánikyálá predisposed him to assign an unduly late date to the Gándhára school.

Mr. Fergusson rightly observed that some of the Gándhára sculptures might be mistaken for early Christian works, but he did not follow out the hint thus given, and the remark, though perfectly true, has not attracted much attention. He supported the observation by a cursory reference to the early Christian sarcophagi and ivories. I have examined the fine collection of ivories, original and casts, in the South Kensington Museum, and, while admitting that some have really an artistic relation with the Gándhára work, I venture to think that the relation is not very close.

The representation of Christ standing under a small arch, supported on fluted columns, with florid capitals of a modified Corinthian form, as seen on the front of the Brescia casket, dating from the fifth or sixth century, is undoubtedly akin to the Gándhára representations of Buddha; and the procession of Joseph and his brethren on the Ravenna chair recalls, though less vividly, some of the processional scenes of the

* Constantinople was formally consecrated as the New Rome in A. D. 330.

Indian reliefs.* But the ivories do not seem to me to be exactly contemporary with the Indian work.

The closest parallels to the Gándhára sculptures in relief are to be found among the remains of early Christian art, though not among the ivory carvings. These parallels are to be found in a place where we should hardly expect them, the Catacombs of Rome.

It would be impossible by any number of pages of mere description to bring home to the reader's mind the reality of the likeness here asserted, but a comparison of the heliogravure plates of the Gándhára sculptures edited by Major Cole with the similar plates of the sculptures in the Catacombs in Roller's work will convince any one who takes the trouble to make it that the connection between the two, however it came to pass, is very close indeed.†

* I shall merely give references to the plates in M. Roller's book which closely resemble Major Cole's.

Pl. XLIII. A sarcophagus, "à demi-païen, à demi-chrétien," from the cemetery of Callixtus, and probably dating from the third century. The arrangement of the whole composition much resembles that of many of the Gándhára reliefs, and the posture of the figure of Psyche is nearly identical with that of Prajapati in the Nativity group from the upper monastery at Nuttu, described *ante*, p. 124.

Pl. XLIV. Sarcophagus of St. Constantia, with vintage scenes and genii; 4th century.

Pl. XLV. Sarcophagus from the Basilica of St. Paul, with various scenes of the life of Christ and His disciples, sculptured in high relief; 4th century. The scenes in this composition are not separated by columns. The resemblance in general effect to some of the best Gándhára sculptures is very strong.

* Westwood, *Descriptive Catalogue of the Fictile Ivories in the South Kensington Museum* (1876), Pl. II, III. Compare the large Catalogue of Original Ivories in the same Museum by Maskell (1872), and the little hand-book by the same writer, entitled *Ivories, Ancient and Mediæval*. Other references are given by Fergusson in *I. and E. Architecture*, p. 182.

† *Les Catacombes de Rome, Histoire de l' Art et des Croyances Religieuses pendant les premiers Siècles du Christianisme*, par Théophile Roller, Paris, Vve. A. Morel et Cie.; 2 vols. large folio n. d., with 100 heliogravure plates. Readers who cannot obtain access to this work or De Rossi's publications may verify the comparison made by reference to "*Roma Sotterranea, or an Account of the Roman Catacombs especially of the Cemetery of St. Callixtus*," compiled from the works of Commendatore De Rossi, with the consent of the author. New edition, rewritten and greatly enlarged, by Rev. J. Spencer Northcote, D. D., Canon of Birmingham, and Rev. W. R. Brownlow, M. A., Canon of Plymouth;" 2 volumes, 8vo., London, Longman's, Green and Co., 1879, with numerous engravings.

Pl. XLVIII. Resurrection of Lazarus, and other incidents; 4th, or possibly, 5th century. The thick, stumpy figures much resemble some of those in reliefs from Nuttu and Sanghao.

Pl. XLIX. Sarcophagus of 4th or 5th century, with a long row of worshippers.

Pl. LIV. Representation of an *agapé* feast; 5th century. The winged genii and other figures much resemble those seen in Gándhára art.

Pl. LVIII. Sarcophagus, of Constantine in the Lateran Museum; 4th century. Relief sculptures with intercolumniations and architrave. Christ is seated in the centre compartment, like Buddha in the Gándhára compositions.

Pl. LIX. The celebrated sarcophagus of Junius Bassus, dated A. D. 359. Various scenes are represented in panels divided by columns. The style is very similar to that of good Gándhára work.

Pl. LX. Five sarcophagi of the 4th century; various subjects.

Pl. LXVIII. Adoration of the magi; 4th century, compare the Gándhára representation of the four kings offering the precious bowls to Buddha. One example of this is in the Lahore Museum, No. 405 of Cunningham's *Descriptive List*, and another, (or possibly the same work), is figured by Major Cole.

Pl. LXIX. The Epiphany; 4th century.

Pl. LXXVI. Elijah ascending to heaven in a four-horsed chariot; 4th, or possibly 3rd, century.

Pl. LXXXI. Sarcophagus, probably of about 5th century.

Pl. LXXXII. Sarcophagus of 5th century.

Pl. LXXXVII. Worship of the *labarum* symbol, the cross enclosed in a circle, elevated in the centre compartment of an intercolumniated relief; 5th century.

This composition has a very strong resemblance to the representation of the worship of the *Trisúla*, the emblem of the Buddhist faith, in Major Cole's volume.

It is, as I have said, impossible by means of mere verbal description to express the intimate relation which exists between the art of Gándhára, and these Christian sculptures from the Catacombs, which range in date from about A. D. 250 to 450; but it is equally impossible for any person to compare photographs of the two sets of objects, and to fail in perceiving the likeness, in some cases almost amounting to identity, of style and treatment. The evident analogy, too, between the representations of the Buddha and the Christ shows that there is a substantial identity of subject, veiled under difference of name, as well as in treatment. The facts invite speculation as to the possibility and probability

of an appreciable amount of Christian influence on the later development of Buddhism, but I cannot venture at present to embark on the tempting, though perilous, sea of conjecture to which such speculation would lead me.

I have shown above that no difficulty exists in supposing that Indian art may have been affected by the Palmyrene variety of the cosmopolitan Roman style. Inasmuch as that style was cosmopolitan, it is impossible to say that any given Indian adaptation of a Roman model was borrowed from the art of Palmyra or any other particular locality. If we find an Indian sculpture nearly identical with one at Palmyra, all that can be safely asserted is, that both have a common origin, and date from approximately the one period, while there is no reason why the Indian imitation should not have been copied directly from a Palmyrene model.

Bearing in mind these explanations, it is interesting to observe that a frieze from the upper monastery at Nuttu, reproduced in Major Cole's Plate 16, figure 1, is substantially identical with the Palmyrene frieze engraved in Wood's Plate 41.

The latter adorns a building which bears an inscription recording the execution of repairs during the reign of Diocletian (A. D. 284—305), who kept a garrison at Palmyra, but the building, and the frieze with which it is decorated, probably were erected about the middle of the third century.

The Nuttu design consists of a vine stem, knotted into five circles, forming small panels; the first of which, to the left, contains leaves only, the second is occupied by a boy or Genius plucking grapes, the third exhibits two boys playing with a goat, the fourth displays a rudely executed goat sitting up and nibbling the vine, and the fifth represents a boy plucking grapes.

At Palmyra, the figures of the boys and goats are wanting, but the design of the knotted vine is absolutely identical with that in the frieze from Nuttu, and the two works cannot be far apart in date. Somewhat similar scroll patterns are common in Roman art, and occur occasionally in other works of the Gándhára school.

The porphyry sarcophagus of St. Constantia, executed in the reign of Constantine (A. D. 306—337), to which I have already referred (*ante*, p. 165), is adorned with a relief exhibiting the pressing of grapes by winged cupids, set in scrolls of vine-stems, bearing a general resemblance to the design of the Nuttu frieze. The subsidiary garland, acanthus leaf, and animal decorations of St. Constantia's sarcophagus all have a strong likeness to the Nuttu sculptures and other works of the Gándhára school.

I venture to maintain with some confidence that I cannot be far wrong in assuming A. D. 300 as an approximate mean date for the remains of the upper monastery at Nuttu. This chronological determination is of special value because the sculptures from this site, though extremely various in subject, are probably all contemporaneous, or nearly so. The whole site occupied an area measuring only about 80 by 60 feet, and 79 objects were found within this small space. Most of these are stone sculptures, which lay round two small *stūpas*, each ten feet in diameter, that occupied the centre of the building. Fragments of plaster figures were found at a distance of a few feet from the miniature *stūpas*.*

The varied collection of sculptures obtained within this small space comprises the Nativity scene, (*ante*, p. 123), the very elegant figure of a woman standing under a conventional palm-tree, (*ante*, p. 124), a specimen of the adaptation of the Rape of Ganymede, (*ante*, p. 134), two examples of the death-bed scene or *parinirvāṇa*, (*ante*, p. 125), and numerous figures of Buddha associated with his disciples, the master being sometimes represented with both shoulders draped, and wearing moustaches, (*ante*, p. 127).

It seems reasonable to suppose that sculptures obtained within such a very limited area, and belonging to one school of art, cannot be very widely separated from one another in date. It is not likely that they were all executed in a single year, but, for the purposes of art history, they may be safely regarded as contemporaneous.

If then I am right in fixing A. D. 300 as the approximate date for this group of subjects, a valuable standard for the chronology of the whole school has been rendered available, and we learn that, at the date specified, all the subjects named had been adopted by Buddhist artists as proper themes for the exercise of their skill.

I cannot attempt to indicate every instance in which the art of Gāndhāra appears to be an echo of that of imperial Rome, and shall quote but few more such instances. The representation of a long roll or undulated garland carried by boys is one of the commonest subjects treated in the Gāndhāra friezes. A specimen is thus described by Dr. Anderson;—"G. 94, *a* to *d*.—Four portions of a frieze. Children supporting on their shoulders a long undulated garland, on which are tied bunches of grapes, and other ornaments; in the drooping folds above which, in some, appear the busts and heads of winged human figures, and, in one, a bird of prey with extended wings, while, in others, the intervals are filled with floral devices."†

* Cole, *Second Report*, p. cxxiii, Pl. 6 (plan and elevation).

† Anderson's *Catalogue*, Part I, p. 241. Cf. Cole's heliogravure plate 7, figures 2, 3.

Numerous illustrations might be quoted in proof of the proposition that designs of this class are Roman in origin, but I shall content myself with referring to one, a frieze found in the Palestrina territory, probably dating from the time of Constantine, which represents a very large garland carried by boys.*

The same subject occurs repeatedly in the sculptures of Amarāvati, though treated in more Indian style. A notable distinction between the methods of treatment in Gāndhāra and at Amarāvati is that the Gāndhāra artists always give the roll an imbricated surface, such as is commonly seen in Roman art, whereas the Amarāvati sculptors mark the surface with lines in a manner of their own. But I suspect that at Amarāvati, as well as in Gāndhāra, the motive was borrowed from Roman art.

The Buddhist artists, following the usual Indian practice, converted the foreign motive to the purposes of their own ceremonial, and, as Sir A. Cunningham has pointed out, used the Roman garland to represent the light serpentine frame of bamboo covered with tinsel, which was carried in procession at Buddhist festivals, as it is to this day in Burma.

I have already referred to the fact that the conventional representation of the *parinirvāṇa* or death-bed of Buddha is borrowed from the sculptures of Roman sarcophagi or Græco-Roman sepulchral reliefs (*ante*, p. 126).

I have also mentioned (*ante*, p. 136) that the representations of winged animals, and marine monsters, and the comic friezes of boys riding on lions and other beasts, so common in the early Buddhist sculptures both of Gāndhāra and India Proper, are ultimately derived from the works of the Alexandrian schools of Greek art, which are supposed to trace their parentage to Scopas.

The early examples of this class of subjects which occur in the interior of India, and are prior in date to the establishment of the Roman empire, must be imitations of Greek models. In all probability the artists of Buddha Gayā and Bhārhut obtained their knowledge of these foreign forms by means of the sea commerce conducted with Alexandria through the inland depot of Ozene (Ujjain), and the port of Barygaza (Bharoch).† At Amarāvati it is possible that the channel of communication was Roman.

The Gāndhāra compositions dealing with similar subjects should be compared, not with Greek art, but with the representations of the

* Visconti, *Museo Pio-Clementino*, Vol. VII, pl. XXXV.

† See the Introduction to McCrindle's translation of the *Periplus of the Erythraean Sea*.

Triumph of Bacchus, and of processions of the Genii Bacchici and Genii Circenses, many examples of which may be seen in Visconti's plates, and in other illustrated works on Roman art. *

It is not easy to determine the chronological sequence of the various remains in the Yúsufzai country.

"The principal groups of ruins," remarks Sir A. Cunningham, "are at Sháhbázgarhi, Sáwaldher, and Sahri Bahlol in the plain; and at Ránígat, Jamálgarhi, Takht-i-Bahi, and Kharkai in the hills. There are similar remains at many other places, as at Topi, Ohind, and Zeda in Utmanzai; at Túrli, Baksháli, and Gharyáli in Súdám; and at Matta and Sanghao in Lúnkhor."*

To this list must be added the ruins of the monasteries at Mián Khán and Nuttu, which lie close to those at Sanghao, and were explored by Major Cole.

The buildings and sculptures of Jamálgarhi were the first described, and are the best known. It is very unfortunate that no accurate record has been kept in many cases of the exact site where certain sculptures were found, and the consequent uncertainty greatly hinders satisfactory discussion. But it is certain that by far the largest proportion of the specimens of Gándhára art in the Indian Museum at Calcutta came from Jamálgarhi, and that some of the best specimens in the British Museum came from the same locality. The Gándhára school was in its prime when the Jamálgarhi sculptures were executed. I have shown (*ante*, p. 163) that the Indo-Corinthian capitals found there are later than A. D. 217. So far as I can see at present, the Jamálgarhi remains do not vary much in style, and their execution cannot be extended over a very long period. The best may be dated A. D. 250, and the latest A. D. 300. Of course, all such dates must be regarded as mere approximations in round numbers.

I have adduced (*ante*, p. 168) reasons for believing that the sculptures from the upper monastery at Nuttu are slightly later, dating from about A. D. 300. Those from the lower monastery at the same site belong to the same period.

The Sanghao sculptures, which are fully illustrated by Major Cole, are in general contemporaneous with those at Nuttu, but some of the Sanghao works look a little later.

Many of the sculptures from Mián Khán, which are illustrated by Major Cole's heliogravures Nos. 23 to 30 inclusive, seem to me superior in execution to, and more Greek in style than, those from other sites. But very little difference can be discerned between the work at

* *Archæol. Rep.*, Vol. V, p. 5.

Mián Khán and the best at Jamálgarhí. Some of the Mián Khán specimens may be as old as A. D. 200, though none, I should think, are older.

As to Kharkai no detailed information is available. Sir A. Cunningham merely notes that he saw a large collection of sculptures from this locality in the possession of Mr. Beckett, and that he obtained a considerable number himself "similar in all respects to the sculptures that have been dug up at other places."* Inasmuch as Sir A. Cunningham's criticisms are chiefly concerned with the objects obtained at Jamálgarhí, it may be assumed that the Kharkai sculptures are not remote in date from those procured at that locality.

"The remains at Sáwaldher, $2\frac{1}{2}$ miles to the east of Jamálgarhí, are mostly covered by the houses of the village, and are, therefore, inaccessible. It is believed, however, that some of the finest specimens in the Lahore Museum were obtained at this place by Dr. Bellow."† If this belief be correct, the Sáwaldher ruins must be as old as those at Mián Khán, and it is possible that some of the buildings may have been older, and contained works tracing their parentage directly to Greek art. It is a great pity that the objects in the Lahore Museum were not properly labelled.

The excavations at Sahri Bahlol proved that the site had been occupied in very ancient times, perhaps as early as B. C. 2,000,‡ and the existence of the *stúpas*, containing the broken statue imbedded in it, proves that Buddhist votaries occupied the place as late as A. D. 500 or 600 (A. D. *ante*, p. 155). The broken statue was particularly well executed, and presumably may be referred to the third century.

The information respecting the sculpture at Takht-i-Bahí is very scanty. Mr. Fergusson, from examination of photographs, judged that the remains at this place are of considerably later date than those at Jamálgarhí, and his judgment on a question of relative date is entitled to the greatest respect.

At Takht-i-Bahí, a court was excavated, surrounded on three sides by lofty chapels, each of which seems to have enshrined a colossal plaster statue of Buddha, some twenty feet, or more, in height. Such colossal plaster images do not appear to belong to a very early stage of Buddhist art, and their presence confirms Mr. Fergusson's suggestion that the remains at Takht-i-Bahí should be placed late in the series. Perhaps A. D. 400 to 450 may be assigned as a tentative date.

To sum up, I accept the numismatic evidence, agreeing as it

* *Archæol. Rep.*, Vol. V, p. 54.

† *Ibid.*, *ibid.*

‡ *Ibid.*, p. 38.

does with the architectural, that the Ionic pillars found in two temples at Taxila, east of the Indus, date from about the beginning of the Christian era, and are, with the exception of a very few sculptures of the same period, the earliest known examples of Indo-Hellenic work in the Panjáb. These pillars I regard as results of the operation of Hellenistic, as distinguished from Roman, influence. Hellenistic ideas can also be traced in the early Buddhist sculptures, which were executed prior to the establishment of the empire of the Cæsars, at Bhárhut, Buddha Gayá, and other places in the interior of India.

The sculptures from the Yúsufzai country, the kingdom of Gándhára properly so called, which lies west of the Indus, in the immediate neighbourhood of Pesháwar, are, I believe, the work of a local school, probably founded by a foreign colony, which drew its inspiration directly from Roman, and only remotely from Greek art. This local school may be conveniently designated either as the Gándhára or Pesháwar school. The name Græco-Buddhist proposed by Dr. Leitner cannot be asserted to be incorrect, all Roman being only a modification of Greek art, but the term Romano-Buddhist would be much more appropriate.

I cannot say what circumstances caused the establishment at Pesháwar of this peculiar local school, but I do not agree with Sir A. Cunningham in associating it with Kanishka and his immediate successors of the Kushán dynasty, A. D. 80 to 200. On the contrary, I am of opinion that the earliest works of the Romano-Buddhist school of Pesháwar date from about A. D. 200, and that all the sculptures of any considerable degree of artistic merit were executed between that date and A. D. 350. The style probably lingered in decay as late as A. D. 450, but not later.

It follows that I hold that there is a wide interval, at present unbridged, between the scanty remains of early Indo-Hellenic work in the Panjáb, and the abundant specimens of later Indo-Roman work.

The style of the Romano-Buddhist sculpture and architectural decoration shows some affinity with the style of the great temples at Palymra and Baalbec, belonging to the second and third centuries A. D., but its closest relationship, (and the connection is very close indeed), is with the Roman Christian sculpture of the period A. D. 250-450, as seen in the catacombs.

I am well aware that the opinions above expressed are open to dispute, and that I am liable to be thought over-venturesome for expressing them in such positive language. They are, however, the result of a careful and prolonged study of the subject, and I submit them for discussion in the confidence that a distinct expression of definite opinions will bring out clearly the issues to be decided, and prepare the way for final judgment.

Section VI. THE INDIAN SCHOOLS OF PAINTING.

The mention of an Indian school of painting must seem absurd to a reader acquainted only with modern India, where no trace of the existence of pictorial art can be discerned, unless the pretty, though conventional, miniatures which a few craftsmen at Delhi are still able to execute, be counted as an exception.

The paintings exhibited in the show rooms of Rajas' palaces, and the decorations of modern temples and private houses are scarcely more deserving of the name of art than the caricatures scribbled by boys on the wall of their schoolroom. In the India of to-day painting and sculpture are both lost arts. The little feeling for beauty that survives is almost confined to small bodies of skilled artizans, and is with them rather the inherited aptitude of the members of a guild for the work of their trade, than a genuine artistic taste. This statement may seem very shocking to the amiable gentlemen who, of late years, have bestowed unmeasured praise upon the æsthetic merits of Indian carpets, shawls, vases, and so forth, but 'tis true 'tis pity, and pity 'tis 'tis true.

My concern, however, is with the past rather than the present, and I must not tilt against South Kensington windmills. Whatever be the merits of modern productions, ancient India certainly produced paintings which deserve to be ranked as works of art. They do not, I believe, deserve a very high rank, when compared with the world's masterpieces—no Indian art work does—but they are entitled to a respectable place among the second or third class. The utter inability of the modern Hindû to express anything human or divine with either brush or chisel produces in the mind of the European observer in India a feeling of surprise when he finds a sculpture or painting which can be described as the work of an artist, and admits of comparison with the productions of Europe, and inclines him to exaggerate the merit of his treasure trove. The Gándhâra or Peshâwar sculptures, which have formed the principal subject of this paper, would be admitted by most persons competent to form an opinion, to be the best specimens of the plastic art ever known to exist in India. Yet even these are only echoes of the second rate Roman art of the third and fourth centuries. In the elaboration of minute, intricate, and often extremely pretty, ornamentation on stone, it is true, the Indian artists are second to none. The stone-cutters in Gándhâra and at Amarâvatî display the same skill in drawing elaborate patterns, and the same skill in executing them, which we now admire in the work of the modern carpet-weavers and vase-makers. But in the expression of human passions and emotions Indian art has completely failed, except during the time when it was held in Græco-Roman leading strings, and it has scarcely at any time essayed an attempt to give visible form to any divine ideal.

Such being the deficiencies of Indian sculpture, the same may be looked for in Indian painting.

The sculptures of Gándhára, Amarávatí, and the Western Caves frequently show traces of paint, from which it appears that the Indians adopted the common Greek practice of using colour to heighten the effect of sculpture. No Indian coloured sculpture, however, has sufficiently retained the pigment to allow modern critics to judge of the effect produced. In Gándhára the gilder's art was freely employed, in addition to that of the painter, in order to add to the magnificence of sculpture. Such extraneous aids, whether employed by Greeks or Indians, seem to our modern taste derogatory rather than helpful to the dignity of sculpture, and, this being so, we need not regret the loss of the pigment and gilding, which would in our eyes have vulgarized sculptures, which we can honestly admire as they stand in naked stone.

But, besides these questionable expedients, the artists of ancient India knew how to supplement sculpture by the art of painting in forms recognized by all to be legitimate. Mr. Fergusson expresses the confident belief that paintings, such as are commonly called frescoes, contributed to the decoration of the Gándhára monasteries. It is very probable that his belief was well founded, but no scrap of any such painting has yet been found, and at present a Gándhára school of painting has only a hypothetical existence.

In Western India the destroying hand of time has been a little more merciful, and has spared enough of the ancient paintings to show that during the first five centuries of the Christian era India possessed artists who could paint pictures of, at least, respectable merit.

Fragments of paintings on walls and ceilings can be detected in the cave temples of the Bombay Presidency at several sites, but the only localities where intelligible pictures have survived, so far as is known at present, are Ajanṭá in the Nizam's dominions and Bágh in the district of Ráth in the south of Málwá. The paintings at the latter place are known only from brief descriptions in Messrs. Fergusson and Burgess' works, which are not sufficient to form the basis for critical discussion.*

Our knowledge of ancient Indian painting is practically restricted to the pictures on the walls and ceilings of the celebrated caves at Ajanṭá. No attempt has yet been made to discuss methodically these interesting

* *Cave Temples of India*, pp. 363-366; and *Notes on Bauddha Rock Temples of Ajanṭá*, pp. 94, 95. Recently a series of remarkable Jain paintings has been discovered at Tirumalai, 30 miles south of Vellore in the Madras Presidency. The paintings belong to two distinct periods, but their dates have not yet been determined. (*Proc. Govt. of Madras*, No. 803, *Public*, dated 11th June, 1887.)

paintings, or to determine definitely their place in the history of art.* I think that any qualified critic who undertakes the study of these works will find that they are well worth attentive examination, from the points of view both of the archæologist and the artist, but such qualified critic, competent to grasp alike archæological and artistic problems, has not yet come forward.

I cannot pretend to write a criticism on the Ajantā paintings. I have not had time to study them minutely, nor have I the technical knowledge requisite to enable me to determine their æsthetic value. But I am fully persuaded that they are to be numbered among the fruits of foreign teaching, either by Greeks, or Roman pupils of Greek masters, and, holding this opinion, I cannot omit all notice of them from an essay which aims at giving a general, though imperfect, view of the manner and degree of Græco-Roman influence on the art and other elements of the civilization of ancient India.

At Ajantā fragments of painting exist in thirteen caves, but the principal remains are found in seven. "The Ajantā pictures are not frescoes in the true acceptation of the term. The painting was executed on a coat of thin, smooth plaster, the thickness of an egg-shell, which was laid on a groundwork composed of a mixture of cowdung and pulverized trap, rice-husks being sometimes added to increase the binding properties of the mixture."†

As regards the style of the pictures Mr. Griffiths' general criticism is to the effect that there is "little attention paid to the science of art—a general crowding of figures into a subject, regard being had more to

* The most competent account of the Ajantā paintings yet published is that given in the second work referred to in the preceding note. The full title of the book is "*No. 9, Archæological Survey of Western India. Notes on the Bauddha Rock-Temples of Ajantā, their Paintings and Sculptures, and on the Paintings of the Bāgh Caves, Modern Bauddha Mythology, etc.* By J. Burgess, M. R. A. S., etc., Bombay, 4to.; Printed by order of Government at the Government Central Press, 1879." This work is now out of print, and sells at double its original price. It is illustrated by twenty-nine plates, uncoloured, fifteen of which are devoted to the paintings.

Four pretty good uncoloured plates illustrate Dr. Rājendralāla Mitra's paper on the paintings in Vol. XLVII (1878) of the Journal of the Asiatic Society of Bengal.

The architecture and sculpture of the Ajantā caves are discussed with great fulness in Vol. IV of the Reports of the Archæological Survey of Western India, and are there illustrated by splendid autotype plates, but the paintings are scarcely noticed in that volume.

The volume of *Notes*, the full title of which has been given above, belongs to a series of minor treatises in paper covers, issued by the Bombay Government preliminary to the publication of the costly and elaborate series of Reports.

† *Indian Antiquary*, Vol. II, p. 152.

the *truthful* rendering of a story than to a *beautiful* rendering of it:—not that they discarded beauty, but they did not make it the primary motive of representation.”*

The range of date of the Ajañtá paintings is very nearly the same as that of the Gándhára sculptures, though some of the former are earlier, and some may be a hundred years, or even more, later than any of the latter. The earliest paintings at Ajañtá, those on the side walls of Cave No. X, are referred by Mr. Burgess to the latter part of the second century A. D. To a large extent the Gándhára and Ajañtá works are certainly contemporary, and it is *primâ facie* probable that, if the sculptures echo the ideas of the art of imperial Rome, paintings of the same period should not have escaped the influence of the cosmopolitan canons of taste which then determined the forms of art. I am not prepared to prove in detail the Greek or Roman parentage of the Ajañtá paintings, but I have little doubt that critical study will prove them to be more Roman than Greek. Their realism, on which Mr. Griffiths comments, is one of the most characteristic features of the Gándhára sculptures, and is thoroughly Roman. Some of the panels, too, filled with elegant floral decorations are extremely like Roman work in appearance.

The Gándhára sculptures are so closely related to the Christian sculptures in the Catacombs of Rome, that I venture to suggest that it would be worth while to compare the paintings in the Catacombs with those in the Ajañtá caves. A hasty comparison of copies of both led me to suppose that they might be related, but I am not in a position to offer a definite opinion on the subject.

The neglect of years has, it is understood, in great part destroyed the original paintings at Ajañtá, and, unfortunately, the fine copies in oils, on which Major Gill spent many years, were mostly consumed by the fire at the Crystal Palace in 1860. A few of his copies then escaped, but, I believe, perished in a later fire at South Kensington. Mr. Griffiths, of the Bombay School of Art, has since made a fresh set of copies of a portion of the paintings, and these copies are now exhibited in the Indian Museum at South Kensington. The ordinary visitor, however, can be little impressed by them, in the absence of descriptive labels or catalogue to indicate the history, meaning, or artistic value of the paintings. I should add that, notwithstanding his remarks on the subordinate place given to beauty as compared with realism in the Ajañtá paintings generally, Mr. Griffiths bestows very high praise on particular compositions, and his judgment is supported by the great authority of Mr.

* *Indian Antiquary*, Vol. III, pp. 25-28. So far as I am aware, Mr. Griffiths' report has not been published in full. Considerable extracts from it are given in the *Indian Antiquary*, and in Mr. Burgess' *Notes*.

Fergusson. One of the most remarkable paintings is in the hall of Cave No. XVI, and is supposed to date from the sixth century. The subject is the death of a lady, apparently a princess. The treatment of it has elicited from Mr. Fergusson the comment that "Mr. Griffiths very justly remarks on this picture that 'for pathos and sentiment and the unmistakeable way of telling its story this picture, I consider, cannot be surpassed in the history of art. The Florentines could have put better drawing, and the Venetians better colour, but neither could have thrown greater expression into it.'"^{*}

Mr. Fergusson also quotes with approval the criticism of Mr. Griffiths on a painting depicting flying figures in the so-called Zodiac Cave, No. XVII:—

"Whether we look at its purity of outline, or the elegance of the grouping, it is one of the most pleasing of the smaller paintings at Ajanta, and more nearly approaches the form of art found in Italy in the thirteenth and fourteenth centuries than any other example there. The easy upward motion of the whole group is rendered in a manner that could not easily be surpassed."[†]

Whether these panegyrics are overstrained or not I shall not attempt to decide, but I am fully persuaded that no art at all deserving of such praise was ever born on Indian soil.

"India, meditated, brooded, elaborated, but the originating imagination is not found in the dream-life."[‡]

Whoever seriously undertakes the critical study of the paintings at Ajanta and Bâgh will find, I have no doubt, that the artists drew their inspiration from the West, and, I think, he will also find that their style is a local development of the cosmopolitan art of the contemporary Roman Empire.

Section VII. THE ART OF COINAGE IN INDIA.

The opinion expressed by Lenormant that the mechanical process of coining money, properly so called, was unknown to the Indians until they learned it from the Greeks after the invasion of Alexander, was vigorously combated by the late Mr. Thomas on several occasions, and, in my judgment, with success. §

^{*} *Cave Temples of India*, p. 307.

[†] *Cave Temples of India*, p. 311.

[‡] This quotation is taken from a letter of my friend Dr. R. Atkinson, the learned Professor of Sanskrit in the University of Dublin.

§ The question is discursively treated in Mr. Thomas' papers on the Earliest Indian Coinage and on Ancient Indian Weights in the *Numismatic Chronicle* for 1884, and in his revised edition of the latter paper in the first volume of the *International Numismata Orientalia*.

The truth seems to be that, though all ancient Indian coinages with the slightest pretensions to artistic merit are ultimately of Greek origin, yet the idea of coining money, and a knowledge of the simple mechanical processes necessary for the production of rude coins originated independently in India, or, at the least, were not borrowed from the Greeks.

Although I agree with Mr. Thomas and Sir A. Cunningham in rejecting the theory of the Greek descent of all Indian coins without exception, it must be admitted that it would be extremely difficult, if not impossible, to prove that any particular ancient Indian coin now extant is older than the time of Alexander the Great. Sir A. Cunningham has ventured more than once on the bold assertion respecting the so-called 'punch-marked' coins, that "many of them are as old as 1000 B. C., and perhaps even older."*

When it is remembered that no stone building, sculpture, or inscription anywhere in India is known to exist, which is older than the reign of Ásoka, some seventy years after the invasion of Alexander the Great, it is clear that a claim on behalf of a coin to an antiquity of 1000 B. C. is very difficult to substantiate. Nothing in India exists, which can be compared with it, that is not seven and a half centuries later in date. The supposition that any Indian coins are to be dated 1000 B. C. is a mere guess, unsupported by a single fact. I cannot venture to name any other date for the beginnings of Indian coinage, for the reason that nothing really is known on the subject. It is possible that certain coins may be very old, but they cannot be proved to be so, and the independent origin of Indian coinage cannot be demonstrated by showing that any given extant piece is older than Alexander. I do not know of the existence of any Indian coin which may not possibly be later than his time.

The really valid reason for denying the Greek origin of the art of coinage in India is that several classes of early Indian coins do not exhibit a single clear trace of Greek influence, whereas they are plainly marked by special Indian characteristics.

The coinage of India in its most primitive form consisted of small, oblong, roughly rectangular plates of silver, without any impression on the surface, but struck to a definite standard of weight, namely, 32 *ratís*, or 58½ grains. A slight improvement was made when these little plates of silver were stamped with rough devices of stars, trees, and so forth. These devices were impressed by means of small punches, not covering the face of the coin, and sometimes it appears that all the various patterns on the surface of a single piece, were not executed at once, but were impressed successively at different times by the aid of several

* *Archæol. Rep.*, Vol. I, p. 70; II, pp. 229, 264, 288.

punches. Coins of this kind, which were struck both in silver and copper, are, therefore, known to Indian numismatists as 'punch-marked' coins. Like the blanks, which presumably preceded them, they are struck to the Indian standard of 32 *ratīs*. This standard cannot, I believe, be in any way connected with the Greek metric system. The punch-marked coins are destitute of legends, but the purely Indian character of their devices and their Indian standard of weight render it incredible that they should be the result of Greek influence.

Other early Indian coins with a general resemblance to the punch-marked pieces were either cast in a mould or struck with a die covering the face of the coin, and some few of the oldest of such cast and die-struck coins, which follow Indian standards of weight, are inscribed with characters of the form current in the days of Aśoka. The devices of these coins are as indigenous as those of the punch-marked class.*

It is, I venture to suggest, by no means unlikely that the use of legends on coins was suggested by Greek example. The earliest inscribed Indian coins are proved by the characters used in their brief legends to belong approximately to the period of Aśoka, whose inscriptions are the earliest examples of the use of the alphabet, afterwards known as Devanāgarī. The history of that alphabet has not yet been satisfactorily traced, and the sudden appearance of long and complicated records inscribed in its characters during the reign of Aśoka is an unexplained mystery. The simultaneous first appearance on Indian soil of stone architecture and stone sculpture in the same reign is another mystery. But, however mysterious be the exact origin of all these sudden innovations, it is tolerably clear that they were in some way the result of the foreign, especially the Greek, influences which certainly affected the policy both of Aśoka and his grandfather. It seems to be a plausible conjecture that the introduction of coin legends about the same time was another effect of the same potent foreign forces.

However this may be, the various kinds of early coins, to which I have alluded above, bear no other mark whatever of foreign origin. It is, therefore, reasonable to conclude that the art of manufacturing

* For discussion of these early Indian coins see the above quoted essays by Mr. Thomas. In Cunningham's *Archæol. Rep.*, Vol. VI, pp. 213-220. Mr. Carlile has attempted a classification of the punch-marked coins, the weights of which are discussed by Sir A. Cunningham in *ibid.*, Vol. XIV, p. 16. The classes of early coins found at Eran are discussed and figured in *ibid.*, Vol. X, p. 77, Pl. XXIV. See also *ibid.*, Vol. II, p. 10; V, p. 154, Pl. XXXI, and VI, p. 167. But the numismatic history of India remains to be written. I assume 1·825 grain as the best established value for the *ratī*, for the reasons stated in *Journal As. Soc. of Bengal* Vol. LIII, part I, p. 146.

such rude coins was invented in India independently of Greek teaching. But this conclusion does not prove that any such coins should be assigned to a very remote period. It is quite impossible to say when the use of blank or punch-marked rectangular pieces of silver or copper of definite weight began, and it is difficult to say when it ended. I suspect that in out-of-the-way corners of India the old-fashioned punch-marked pieces continued to be struck centuries after coins of more regular fabric had become familiar in the more advanced parts of the country, and that specimens of the ancient, indigenous coinage long continued in circulation side by side with pieces struck in imitation of foreign models. At the present day the people of the districts between Fyzabad and Patna obstinately cling to the custom of using the clumsy, mis-shapen lumps of copper, known as 'dumpy' or 'Gorakhpurí pice,' and refuse to circulate the well-executed, and, to European notions, convenient copper coinage issued from the British mints. During the past year the Government of India has found itself compelled to make an effort to suppress by law the currency of the unauthorized 'dumpy pice.' The mere form, then, of any given punch-marked or other rude uninscribed coin is a very imperfect test of its age.

So far as I can learn, no definite evidence is producible to show that any Indian coin now extant is of earlier date than B. C. 300. The complete absence of all traces of foreign influence on the Indian coins of the most primitive form renders probable the hypothesis that some of them were struck before India entered into at all intimate relations with the peoples of the West, but that is the most that can at present be said in favour of the alleged extreme antiquity of some Indian coins. The arguments of Mr. Thomas, so far as they are based on the references to coins in the Code of Manu and other early Sanskrit books, cannot be regarded as valid, when viewed in the light of modern research into the chronology of Sanskrit literature.

The rare, but now well-known coins of Sophytes, a prince in the Panjáb, who was contemporary with Alexander the Great, are rather earlier than any indigenous Indian coins can be proved to be, and are altogether Greek in device and legend, though perhaps not in weight-standard. They are modelled on the pattern of coins of the Seleucid kings of Syria.*

The extensive mintages of the Græco-Bactrian kings (from B. C. 246 to *circa* B. C. 25) were mostly issued in countries beyond the limits of India, but long circulated freely in the Panjáb, the valley of the Ganges, and the ports of the western coast.

* Gardner, *Catalogue of Coins of Greek and Scythic kings of Bactria and India*, p. xx.

No known coin can be determined to have been issued by the great *Asoka* or any member of his dynasty. The few legends found on coins of the period give no clue to the name of the reigning sovereign. *Asoka* must have struck coin to a large extent during his long reign, and, as not a single piece bearing his name has been found, the only possible conclusion is, that the bulk of his coinage consisted of the rude, uninscribed pieces above referred to. These coins were struck, as we have seen, to the Indian standard, and they circulated side by side with the Græco-Bactrian issues, specimens of which are found in large numbers all over Northern India.

The general adaptation in India of Greek or Græco-Roman types of coinage was the result of the Indo-Scythian invasions about the beginning of the Christian era. The indigenous Indian coinage consisted of silver and copper. I cannot undertake to say that gold coins were absolutely unknown in India before the Indo-Scythian invasions, but, if they existed, they were insignificant in quantity, for not a single specimen of them has ever been discovered. The earliest gold coins struck in India, which follow the indigenous scale of weights, are the heavy coins of Chandra Gupta II of the Gupta dynasty, and these are not earlier than A. D. 400. All coins of the Gupta dynasty are die-struck, and their outward form, whether they follow the Indian or the Greek weight-standard, is ultimately derived from Greek originals.*

The Indo-Scythian kings introduced a regular gold currency into India and struck vast quantities of gold coins, as well as of copper. Their gold coins combine various foreign elements, but are essentially Roman *aurei*, equivalent to Greek *staters*. The Gupta coinage is related to the Indo-Scythian, and its devices exhibit faint traces of Greek artistic power as late as A. D. 400. After the break-up of the Gupta empire about A. D. 480, the coinage of India became utterly barbarous, and lost all marks of Hellenic influence on design, legend, or standard.

As regards the origin of coinage in India my opinion, in short, is that the art of coinage in rude forms arose in India quite independently of Greek teaching. Neither the invasion of Alexander the Great, nor the example of his Bactrian successors sufficed to induce the princes of India to abandon their indigenous style of coinage. One petty chief in the Panjáb, Sophytes by name, struck coins after the Greek fashion, but found no imitators in the interior of India. *Asoka* and the other sovereigns of the Maurya dynasty continued to issue coins of the old native pattern, on which they did not even inscribe their names.

* For information in detail about the Gupta coinage I must refer to my paper on the Early or Imperial Gupta Dynasty of Northern India in the *Journal of the Royal Asiatic Society* for 1889, pp. 1-158, with five plates.

The general (though not universal) adaptation of Greek numismatic forms copied from Roman coins was the work of the Indo-Scythian dynasties, whose rule in the Panjáb began a little before the Christian era, and spread over all Northern India during the three following centuries. The introduction of coins of Greek type was synchronous with the development of an extensive gold currency, which partly replaced, and partly supplemented the existing issues in other metals.

The Gupta coinage A. D. 350 to 480 is a development of the Indo-Scythian.

From the fall of the Gupta empire to the establishment of the Muhammadan power all Indian coinages are barbarous and chaotic, and completely destitute of artistic merit.*

The die-cutters of India never attained any high degree of excellence in their art. Those of Bactria, as distinguished from India, produced coins, not, indeed, approaching in beauty those of Syracuse, but possessing characteristics which entitle them to respectful consideration as works of art.

Professor Gardner observes;—"In the types used by Greek kings we find great variety, and they open to us quite a new chapter of Greek art, affording fresh proof of the remarkable originality of the artists of the Hellenistic age.

"In regard to the style we may note two points: (1). The extraordinary realism of their portraiture. The portraits of Demetrius (pl. II, 9), of Antimachus, (V, 1), and of Eucratides, (V, 7), are among the most remarkable which have come down to us from antiquity, and the effect of them is heightened in each case by the introduction of a peculiar and strongly characteristic head-dress, which is rendered with scrupulous exactness of detail.

"(2). The decidedly Praxitelean character of the full length on the reverses. The figures of Herakles (pl. II, 9; III, 3), of Zeus (IV, 4; VII, 2), of Poseidon, (V, 1), of Apollo (V, 4; IX, 10), are all in their attitudes characteristic of the school of Praxiteles."†

Some of the Bactrian coins were struck within the limits of the territories now known as India, but most of them were minted beyond the border, and the Bactrian coinage, as a whole, is foreign to India.

* My remarks must be understood as applying only to Northern India in the widest sense. The system of coinage in Southern India has always been quite distinct, and I do not profess to have studied its history. The Peninsula was never brought into really close political relations with Northern India until the establishment of the British supremacy. Even Aurangzib's protracted campaigns did little to bridge over the gulf between the two regions.

† *Catalogue of Coins of Greek and Scythic kings of Bactria and India*, p. lviii.

I do not propose to discuss its relations with the general course of Greek art, and refer to its peculiarities only to enquire how far they affected the art of coinage in India.

The realistic portraits executed by the Bactrian artists were beyond the powers of the Indian die-cutters. The Indo-Scythian coins, except the very latest, are well executed pieces of metal work, but, without exception, almost totally wanting in artistic merit. The effigies of the kings are conventional, and the whole design is stiff and formal. Some of the Gupta coins display more freedom and originality in design, but not a single example of a recognizable portrait can be found, I believe, either in the Indo-Scythian or Gupta series.

The influence of the second peculiarity of the Bactrian coinage noted by Professor Gardner can be discerned in the Gupta series, though not, I think, in the Indo-Scythian. The peculiar attitude of the standing statues of the school of Praxiteles consists in this that the weight of the body is thrown on one leg, the figure being inclined to one side, and bent in a graceful curve so that the hip on the other side is arched outwards. This peculiarity, which in the hands of a good Greek artist, added grace to the representation of the human form, was imitated by the Græco-Bactrian mint masters with considerable success. It caught the Indian taste, but, in the hands of clumsy imitators, was converted into a hideous deformity. An inartistic exaggeration of the Praxitelean attitude is characteristic of many of the Gupta coins of the fifth century, and of much Indian sculpture from an early date until the present day.

Unhappily the history of Indian art, is, as observed by Mr. Ferguson, a history of decay, and the criticism, passed by Sir A. Cunningham on Indian sculpture, applies, *mutatis mutandis*, to other arts:—

“It is a fact, which receives fresh proofs every day, that the art of sculpture, or certainly of good sculpture, appeared suddenly in India at the very time that the Greeks were masters of the Kábul valley, that it retained its superiority during the Greek and half-Greek rule of the Indo-Scythians, and that it deteriorated more and more the further it receded from the Greek age, until the degradation culminated in the wooden inanities and bestial obscenities of the Brahmanical temples.”*

The employment of fairly well-executed Greek legends on the coins of the Indo-Scythian kings of the first two centuries of our era proves that the epithet ‘half-Greek’ applied to their rule by Sir A. Cunningham is not unsuitable. Kanishka and his successors would not have impressed Greek legends on their coins, unless the Greek language had considerable currency among their subjects. I do not, of course, mean

to suggest that Greek was ever commonly spoken or read in India, but it must certainly have been understood by many of the court officials. The language in the time of Kanishka and Huvishka probably occupied a position similar to that of the English language in India forty or fifty years ago, previous to the development of the existing system of public instruction.

The knowledge of Greek seems to have lingered longest in Gujarát. Corrupt Greek letters are found on the silver coins of Skanda Gupta struck in that region as late as A. D. 450, and they also occur on similar coins of his father and grandfather. The letters on these coins are unmistakeably Greek in form, but meaningless, and are evidently imitations of legends, which were once significant, executed by men unable to read Greek. It is plain, therefore, that even on the western coast, where the agency of maritime commerce had for centuries maintained an active intercourse with the Hellenistic world, all knowledge of the Greek language had died out by A. D. 400. In Northern India such knowledge seems to have been lost two centuries earlier.

It is curious that not a single Greek inscription, other than coin-legends, has yet been discovered either in India or in Afghanistan.

The numismatic facts, to which I have briefly referred, help to render credible and intelligible the alleged Greek influence on Indian literature, science, and philosophy, to the consideration of which I shall now devote a few pages.

Section VIII. THE ORIGIN OF THE INDIAN DRAMA.

The existence of a considerable ancient dramatic literature in the Sanskrit language was made known to European readers at the close of the last century by Sir William Jones' translation of *Sakuntalá*, a charming pastoral play, which is, perhaps, the only Sanskrit work that has taken a place among the literary classics of the world.

Since Sir William Jones' time the Sanskrit plays have attracted many students and translators, notably Horace Hayman Wilson, whose well-known work, *Specimens of the Theatre of the Hindus*, is still the leading authority on the subject.

The question of the origin and affinities of the ancient Indian drama has excited the curiosity of scholars, from the time of its discovery until the present day, and various attempts have been made to solve the problem.

The circumstance that the Sanskrit name for a dramatic composition is derived from a root which conveys the idea of dancing naturally suggested the theory, which readily found favour, that "the Indian drama arose, after the manner of our modern drama in the Middle Ages,

out of religious solemnities and spectacles (so-called 'mysteries'), and also that dancing originally subserved religious purposes."*

But this plausible theory has, unfortunately, very little historical basis, and a rival theory that the dramatic literature of India is a direct descendant of the epic seems not to rest on any more solid foundation.†

It is not improbable that rude pantomimic representations of the incidents of sacred stories, resembling the modern Rāmlīlā, may have been as popular in ancient times as they are now, but even if they were, they could hardly be regarded as the parent of the Indian drama. Such exhibitions in their modern form, of which alone anything is known, remain unchanged from year to year, and appear quite incapable of literary development. Their ancient predecessors, if any existed, cannot be credited with any greater power of generating literature. The Sanskrit drama includes pastorals, elaborate comedies of real life, complex pictures of political intrigue, and other varieties of highly artificial composition. The gap between such compositions and a clumsy 'mystery' like the Rāmlīlā is vast and unbridged, and the interval between them and displays of sacred dancing or formal recitations of epic episodes is equally wide.

The Indian drama, as Professor Weber remarks, "meets us in an already finished form, and with its best productions." Whence came this finished form; was the ripe fruit not preceded by seed or flower?

It is impossible to believe that the "finished form" sprang, Minerva like, from the head of Kālidāsa. The dramatic literature of India, like all other ripe productions of art in all countries and ages, must be either the result of an independent, and therefore slow, process of evolution worked out on native soil, or be the more sudden effect of the fertilization of an indigenous germ by a potent foreign influence.

The latter solution of the problem, is, I have no doubt, the true one. It is not easy to disentangle the life history of the indigenous germ, concerning the true affinities of which opinions may well differ,‡

* Weber, *History of Indian Literature*. (Trübner), p. 197. This theory is well expressed in the brilliant article on Sanskrit Poetry and the Hindu Drama by Dean Milman, which appeared in the *Quarterly Review* for 1831. Dean Milman considered that the Indian plays more closely resembled the Spanish than those of any other European country.

† Brockhaus, who denies all Greek influence on the Indian drama, maintains the epic theory. I have not seen his writings.

‡ Windisch himself (p. 6) admits that the Epics contain a dramatic element, and that the Indian drama was indebted to some extent, as the Greek also was, to the epos for help. He is of opinion (p. 8) that dramatic representations, based on epic stories, existed in India before foreign influences were felt, such representations being simply due to the natural desire to see, as well as hear, the stories. This

but the vivifying foreign influence can be isolated, and subjected to microscopic investigation.

That foreign influence which gave India her noble dramatic literature is the same which bestowed upon her the arts of the painter, sculptor, and engraver—the undying spirit of Hellas. India received this, her spiritual guest, but for a little while and grudgingly. When he took wing and fled to more congenial dwelling places the arts soon followed in his train.

Professor Weber was the first to suggest that the representation of Greek dramas at the courts of the Hellenistic kings in Bactria, the Panjáb, and Gujarát awakened the Hindú faculty of imitation, and thus led to the birth of the Indian drama; but the suggestion was qualified, and almost negatived, by the remarks appended to it that the hypothesis does not admit of direct verification, and that no internal connection between the Greek and Indian dramatic literature can be proved.

The Danish scholar, E. Brandes, accepted the hypothesis thus doubtfully propounded, and, rejecting the limitations imposed by its author, boldly undertook to prove the reality of an internal connection between the ancient Indian plays and the New Attic Comedy, as chiefly preserved in the Roman adaptations by Plautus and Terence. I have not seen Dr. Brandes' treatise, nor could I read it if I had, but, fortunately for that large class of persons who are ignorant of Danish, substantially the same thesis has been ably argued by Dr. Windisch in a language more generally intelligible.*

It would be impossible to do full justice to Dr. Windisch's argument otherwise than by a complete translation of his essay. I shall merely attempt to indicate in general terms the nature of some of the leading proofs on which he relies in support of the proposition that the Sanskrit drama is of Græco-Roman parentage.

The general probabilities in favour of the theory that the Indian plays are derivatives of the New Attic Comedy of the school of Menander rest chiefly on the evidence which proves an active and long-continued intercourse between the east and west. Some of this evidence has already been considered (*ante*, p. 157). A special agency for the diffusion of knowledge of the forms of Greek drama among Oriental popu-

opinion seems to be pure conjecture, and is not shared by my learned friend Professor Atkinson. Windisch also holds (p. 10) that epic recitation, and not a lyrical performance associated with music and dancing, was the germ of the Indian drama.

* *Der Griechische Einfluss im Indischen Drama.* Von Ernst Windisch. Aus den Abhandlungen des Berliner Orientalisten-Congresses. 8vo, pp. 106. Berlin, A. Asher and Co, Weidmannsche Buchhandlung, 1882.

lations was furnished by the travelling companies of players, who are known to have traversed the Hellenistic kingdoms; and the poets, as well as the players, were not averse to travelling. Menander and Philemon were both invited to the court of Ptolemy Soter.

Greek ideas entered India chiefly by two routes, one overland through Palmyra and Bactria, the other maritime through Alexandria and the ports of the western coast, especially Barygaza, the modern Bharoch. We know from the anonymous *Periplus of the Erythræan Sea*, which was written between A. D. 80 and 89,* that a very active commerce was then carried on between Barygaza and the inland city Ozéné (the modern Ujjain in Sindia's territory), where Asoka had once been Viceroy, and which, in the time of the author of the *Periplus*, was the great depôt of the foreign trade.

The scene of the 'Toy-Cart,' the most ancient Indian drama extant, is laid at Ujjain, and several considerations lead Dr. Windisch to conclude that the Indian drama was first developed at that city, as a direct consequence of intercourse with Alexandria. The few known facts in the history of the Bactrian king Menander, who flourished about B. C. 110,† indicate that the overland communication between India and the West must have been briskly maintained in his time. The importance of Palmyra as a commercial depôt (*ante*, p. 157) was of later date. Before the Christian era the Western communications of India were with the Hellenized kingdoms of Asia and Egypt. In the first century after the Christian era they were extended to Rome and the Roman provinces. It is, in my opinion, not at all unlikely that the New Attic Comedy was known to learned men in India through the Latin adaptations of Plautus and Terence as well as in the original Greek.

Whether it be admitted or not that the Indian drama is of foreign origin, no one, I suppose, will venture to deny that ample opportunities existed during several centuries for the importation of all sorts of Greek ideas, dramatic or other.

In the opinion of Dr. Windisch the cumulative effect of the evidence of resemblance in particular points between the Indian and Græco-Roman dramas is so great that "we must recognize either a wonderful case of pre-established harmony, or the existence of Greek influence on the Indian drama." The dilemma appears to me to be expressed with perfect accuracy, and I am fully convinced of the reality of the Greek

* The proof is given in the Introduction to McCrindle's translation.

† This is the date adopted by Professor Gardner in his *Catalogue of Coins of the Greek and Scythic kings of Bactria and India*.

influence on the Sanskrit drama, and further, that without that influence the dramatic literature of India would never have come into existence.

The formal structure of the Sanskrit dramas closely resembles that with which we are familiar in Plautus and Terence. Like the Græco-Roman, the Indian plays are divided into acts and scenes, and each piece is preceded by a prologue. The mere fact of the existence of the prologue in the Indian, as in the European plays, is in itself surprising, and can hardly be regarded as a merely casual coincidence. The improbability that it is such becomes much greater when we observe that in both cases the prologue is devoted to the same purposes, the announcement of the names of the poet and the play, the gaining favour of the spectators, and the preparation of their minds for the piece itself.

Again, it cannot well be the result of accident that the love-story of the Indian drama is in plot, development, and *dénouement* essentially of the same kind as that of Græco-Roman comedy. The plot of the 'Toy-cart,' the most ancient Indian play extant, may be accurately described in the words applied by Rost to the *Curculio* of Plautus:—"The subject of this comedy is very simple, and depends, as usual, on a secret intrigue, the lover's want of money, and the supplanting of a rival."

The fair *Perditas* of Plautus and Terence, who eventually prove to be high-born daughters of Athenian citizens, find their parallel in the maid-servants of the Indian plays (*Mālavikāgnimitra* and *Ratnāvalī*), who turn out to be princesses in disguise; and the *ἀναγνώρισμός*, or recognition of the disguised young lady, which is a critical incident in nearly every Græco-Roman play, is repeated, merely with variations of detail, in the Indian adaptations.

Other stock characters of the Terentian comedy have also been imported into the Sanskrit drama.

The *parasitus edax*, the *miles gloriosus*, and the *servus currens*, so familiar to all readers of the Græco-Roman comedies, are reproduced respectively as the *viṭa*, *śakāra*, and *vidūshaka* of the earliest Indian drama. The external origin of these strongly marked characters, is clearly indicated by the facts that the three personages are found together only in the 'Toy-cart,' the oldest drama, which was composed while India was still in communication with the Hellenistic world, and that all three were discarded by Bhavabhūti, who lived about A. D. 700, when Greek influence had ceased to directly affect India. Dr. Winisch's detailed analysis of these characters is very interesting, but is too long for reproduction.

One striking argument, however, must not be omitted. The Sans-

krit author Bharata, who wrote a technical treatise (*nāṭyaśāstra*) on dramatic art, lays down the rule that the players should be five in number, namely, the *sūtradhāra*, his assistant, the *pāripārśwaka*, the *viṣa*, *śakāra*, and *vidūṣhaka*. This enumeration, Dr. Windisch points out, is equivalent to a list of the regular male personnel of a Græco-Roman play, but does not apply to any extant Indian play, except in so far that all the five personages named appear in the 'Toy-cart,' in which alone the *śakāra* is found. The *viṣa* is met with in only one other piece (*Nāgānanda*). It is therefore difficult to understand why Bharata should have laid down this rule, unless pieces were extant in his time which conformed to it, and these pieces must have resembled the Greek models at least as closely as the 'Toy-cart' does.

The repulsive character of the *lena*, or *μαστροπός*, the go-between and corrupter of maiden virtue, is faithfully reproduced in the character of the mother of Vasantāsenā in the 'Toy-cart,' and the elevation of Vasantāsenā herself to a respectable position by the force of unselfish love may be compared with the story of Silonium in the *Cistellaria* of Plautus. The very name of the 'Toy-cart' (*mṛichchhakatikā*) recalls the names of Plautine plays such as *Aulularia* and *Cistellaria*.

The essay by Dr. Windisch, from which I have quoted, does not exhaust all the arguments which might be adduced in support of his thesis, and the partial analysis of his reasoning given above is far from presenting the case, as stated by him, in its full force. Yet, even what has been advanced in the foregoing pages should, I venture to think, suffice to shake the faith of those who believe in the indigenous origin of the Sanskrit drama, and to prove that strong reasons exist for holding the opinion that India is indebted for the existence of the most generally attractive department in the vast circle of her literature to contact with the artistic Hellenic mind.

It is, perhaps, necessary to observe that no one contends that any extant Indian play is a translation or free adaptation of a given Greek piece. That certainly is not the case. The best Indian plays are the work of native genius of high order, employing native materials in its own way, and for its own ends, but first set in motion by a powerful impulse received from abroad. The case of the drama is analogous to that of the Amarāvati sculptures. I agree with Mr. Fergusson in thinking that those sculptures would never have come into existence, if the latent powers of Indian artists had not been aroused and stimulated by the example and teaching of Greek, or at least of Hellenistic, sculptors, but no one would maintain that the carvings now on the staircase of the British Museum should be classed among the remains of Greek art. They are thoroughly Indian in subject and style, and skilled criticism

is needed to discern the hidden foreign element. So it is with the drama. The plays are Indian, but the idea of composing such plays is Greek.

The case of the sculptures of the Gándhāra or Peshāwar school, which I have discussed at such length, is on the contrary, analogous rather to an Indian free translation or adaptation of a Greek play. Those sculptures are close imitations of the contemporary, especially the Christian, art of the Roman empire in the third and fourth centuries, and this fact lies on the surface, visible to any commonly attentive observer. The Roman or Christian subjects have been made to serve Buddhist purposes, but have been transferred bodily to India with little change, save that of name.

Section IX. GRÆCO-ROMAN INFLUENCE ON THE RELIGION, MYTHOLOGY, SCIENCE, AND PHILOSOPHY OF INDIA. CONCLUSION.

A smile will, I fear, pass over the gentle reader's countenance when he compares the promise of the title with the performance of the few pages of this section of my essay. A discussion, in any degree adequate, of the topics mentioned in the heading would require the ample room of an octavo to itself, the writer of which should be equipped with a store of varied knowledge to the possession of which I can make no pretension. So far as I am aware, no one has yet attempted such a survey of the religion, mythology, science, and philosophy of India as would give a general view of the boundaries which divide the indigenous components from the foreign. A slight, rough sketch of a survey of the kind will be found in Weber's *History of Indian Literature*, but a map drawn in more distinct colours is much wanted. I cannot attempt to draw it. The preceding pages will, perhaps, have succeeded in convincing at least some readers that the best elements in the plastic, pictorial, numismatic, and dramatic arts of ancient India are of foreign, chiefly Græco-Roman, origin. In these concluding pages I merely wish to point out that the foreign influence was not confined to those fields, where I have traced its workings in some detail, but extended also to other regions of thought. I am not prepared to follow in detail its operations within those regions, nor to catalogue the instances where its presence may be discerned, and can only offer some unsystematic observations.

The Indo-Scythian coin series affords obvious and conclusive evidence that about the beginning of the Christian era the religions of India and those of the neighbouring countries to the west were acting and re-acting upon each other.

The worship of Siva was certainly then established among

other cults, in India, and the figure of the god, armed with his trident, and standing beside his sacred bull, is, perhaps, the commonest mythological device of the Indo-Scythian coins. But he is not exactly the Śiva of the mediæval Purāṇas, a Hinduized aboriginal demon. Sometimes he is hardly to be distinguished from the Greek Poseidon, and the Greek writers on India themselves perceived that he was akin to Dionysus. Dr. Windisch shows that all the Sanskrit plays are associated with the worship either of Śiva or his consort Gaurī, and that they were generally performed, like the Greek dramas, at the spring festival. It seems probable that the Hellenistic settlers in India transferred to Śiva some of the honour due to Dionysus, and the idea of the Indian deity must have been influenced by the Greek conception of those gods in the Olympic pantheon who most nearly resembled him.

Some rare coins of the great Indo-Scythian emperor, Kanishka, bear the name of Buddha, BOVΔO in Greek characters, and afford us the earliest known examples of the conventional effigy of the teacher.

Other Indo-Scythian coins, again, present figures of the personified Sun and Moon, as Greek deities, with their Greek names Helios and Selēne, while many others represent a pantheon of Iranian deities, bearing such strange names as Oksho (Okro), Ardethro, and so forth, the meaning of which is only now beginning to be understood. I cannot here pursue this topic further, and only allude to it for the purpose of indicating that both a little before, and a little after, the Christian era Hellenic and Asiatic forms of religion were interacting, and that both Buddhism and Hinduism must have been modified by the contact with other modes of religious belief.

Even so late as A. D. 400 the devices of the Gupta coins show that the conceptions of Hindú divinities were partly based on Græco-Roman ideas. Lakshmī, the goddess of plenty and good fortune, is invested with attributes plainly borrowed from the *ῥύχθ*, Abundantia, and other personifications of abstract ideas current in the west. The conception of Lakshmī, the consort of Vishnu, glides imperceptibly into that of Párvatī, Durgá, or Gaurī, the consort of Śiva, and is related to some of the forms both of Venus and Cybelé.*

The apparent resemblances between the Purānic legend of Krishna and the Gospel accounts of Christ are well known, and have formed the subject of much discussion. I am inclined to believe that the Krishna myth is really indebted to the Gospels for some of its incidents.

* For the Indo-Scythian coins see Gardner's Catalogue, and articles by Stein, Cunningham, West, and Rapson in the *Babylonian and Oriental Record* for 1888 and 1889, and *Indian Antiquary* for April 1888. For the Gupta coinage see *Journal R. As. Soc.* for 1889, p. 25, etc.

In the early centuries of the Christian era the religion of Christ in one or other of its forms extended over many parts of Asia where it is now extinct, and it *must* have modified the ideas and beliefs of the peoples among whom it flourished. The Gnostic variety or corruption of Christianity was especially popular in the East, and strong reasons exist for believing in Gnostic influence on the Vedantist philosophy of India. The Bhagavad-Gîtâ certainly seems to have much in common with the Gospels.*

The extraordinarily close resemblance between many of the sculptures of the Gándhára or Pesháwar school, and the monuments of early Christian art at Rome, which was first observed by Mr. Fergusson, has been discussed at some length in an earlier section of this paper (*ante*, p. 164). The resemblance is certainly real, and, however it may be explained, proves with equal certainty that the Christian and the Buddhist artists had many ideas in common. The Buddhism of Gándhára beyond doubt borrowed Christian forms of artistic expression; it would be strange if the Buddhist teachers did not assimilate, along with the forms, some Christian doctrine. But any attempt to follow this speculation further would carry me beyond my depth.

The Gándhára adaptation of Leochares' group representing the Rape of Ganymede (*ante*, p. 133) shows clearly how easy it was for the ancient Indians to adopt a Greek myth, and convert it to the use of their own religions.

Weber maintains that a substratum of Homeric legend underlies the Rámáyana, and gives good reasons for his opinion. The mere fact that such a suggestion can be supported by plausible arguments indicates that the student of comparative mythology must be careful not to assume the Indian origin of every myth which may have on the surface a purely Indian appearance.

I have shown above (*ante*, p. 133) that the Asuras of Puránic mythology are probably Hinduized adaptations of the Greek giants, who warred with the gods.

The remarkable fact that no images of Buddha are found among sculptures at Bhárhut (B. C. 150), and Sánchi (A. D. 80), while they are numerous at Amarávati (A. D. 180),† suggested to Mr. Fergusson

* See the translation of Dr. Lorimer's 'Appendix to the Bhagavad-Gîtâ' in *Indian Antiquary*, Vol. II, p. 283. That author quotes St. Chrysostom, who died A. D. 407, to prove that a translation of the New Testament into some Indian language existed in his time.

† This is the approximate date of the outer rail. The inner rail is later, and some sculptures date from before the Christian era. The remains at Amarávati illustrate the period from about B. C. 100 to A. D. 250 (Burgess, *Buddhist stūpas of Amarávati and Jaggayapeṭā*, p. 112).

the bold speculation that the multiform idolatry of modern India is due to contact with the image-worshipping Greeks. Mr. Fergusson thus expresses this daring hypothesis in his latest work :—

“ I suspect that when the matter comes to be carefully investigated, it will be found that the Indians borrowed from the Greeks some things far more important than stone architecture or chronological eras. It is nearly certain that the Indians were not idolators before they first came in contact with the Western nations. The Vedas make no mention of images, nor, so far as I can learn, [do] any of the ancient scriptures of the Hindus. * ”

“ Buddhism is absolutely free from any taint of idolatry till after the Christian era. So far as we can at present see, it was in the Buddhist monasteries of the Gándhára country, where the influence of Græco-Bactrian art is so manifestly displayed, that the disease broke out, which was afterwards so completely to transform and pervade the outward forms, at least, of all the ancient religions throughout India.”*

The propositions thus stated with Mr. Fergusson's customary directness cannot be implicitly accepted, although they embody a considerable amount of truth. It is not safe to affirm that Buddhism before the Christian era was absolutely free from idolatry, for the Taxilan Buddhist temples, adorned with plaster images, were probably erected at the close of the first century B. C. and we do not know, though we may reasonably suspect, that the images are of later date. Statues found at Mathurá, and certain coins of Kanishka (*circa* A. D. 78 to 110) prove conclusively that images of the teaching Buddha in his conventional attitudes, both seated and standing, were well known at the close of the first century A. D.† It is rash to affirm that they were unknown a hundred years earlier. A colossal statue of the standing Buddha discovered by Sir A. Cunningham at Srávastí (Sáhet-Máhet) in 'Oudh seems to be slightly older than the Mathurá images.‡

It is, however, quite true that in Bihár, Central and Western India, no image of Buddha earlier than the Christian era, or perhaps than A. D. 150, is known, and Mr. Fergusson appears to have been right in holding that the worship of images of the founder of Buddhism was introduced from the North West; and it is probable that the development of sculpture, which was undoubtedly stimulated by Hellenic influence, gave encouragement to idolatrous practices.

Among all the departments of Sanskrit literature the elaborate

* *Archæology in India* (London, Trübner and Co., 1884).

† Cunningham, *Archæol. Reports*, Vol. V, p. vii; and Gardner's *Catalogue*, pp 130, 175.

‡ Cunningham. *Archæol. Rep.*, *ut supra*, and Vol. I, p. 339.

system of Hindú logic, and the marvellous, almost miraculous, structure of grammar erected by Pāṇini and his successors have the greatest appearance of absolute originality. Yet some competent scholars are disposed to seek a western origin even for these. The true position of the Sanskrit logicians and grammarians in relation to the teachers of other countries cannot be satisfactorily determined until the main outlines of the chronology of Sanskrit literature are settled definitely within narrow limits of possible error. The radius of error is gradually being reduced, but a long time must elapse before it is brought within an approximation of zero.

In one branch of Indian science the operation of direct and potent Greek influence, however it may once have been doubted, has been fully demonstrated, and is now admitted by all writers competent to form an opinion on the subject. Indian astronomy, in its exacter form, as taught in the Sanskrit text-books is essentially the astronomy of the Alexandrian schools, and its technical nomenclature is to a large extent Greek in a slight disguise. An earlier, inexact astronomy, probably of Babylonian origin, had been known in India long before the works of Alexandrian professors reached her shores, but all Indian astronomy with any claim to scientific precision is Greek. This scientific astronomy was taught by Āryabhaṭā in A. D. 500, and by Varāha Mihira about half a century later, but it was probably known to some persons in India at a considerable earlier date.*

It is obvious that highly abstruse and technical works like the treatises of the Alexandrian astronomers could not have been mastered by the Indian astronomers except by textual study at a time when the Greek language was still intelligible to learned men in India. The extensive importation of Greek technical terms into the vocabulary of Hindú astronomy shows that the Greek works themselves must have been read in India, and also proves that the ideas expressed by those terms were unfamiliar to the native scholars. If the ideas had been familiar, Sanskrit words to express them would have existed, and, if such words had existed, they would have been used, and the foreign terms would not have been imported. The necessity under which the Hindú astronomers lay of borrowing Greek scientific terms by the score

* Pandit Shankar Balkrishna Dikshit observes that there are two distinct and separate astronomical works, each bearing the name of Āryabhaṭā as its author. The first (to which reference is made in the text), known as *Āryabhaṭīyā*, or *Ārya Siddhānta*, bears the date Śaka-saṃvat 421 expired, = A. D. 499-500. It has been published by Dr. Kern. The second work, known as the *Laghu-Ārya-Siddhānta*, was composed at some time between A. D. 628 and 1150, and appears never to have been printed. These two distinct works are said to have been sometimes confounded by European writers. (*Indian Antiquary*, Vol. XVII (Nov. 1888), p. 312).

is very strong evidence that their native astronomy was, from the purely scientific point of view, extremely imperfect.

The knowledge of actual Greek books displayed by the Indian astronomers also shows that there is no improbability in supposing that a limited class of readers in India had studied the texts of Greek plays. Dr. Windisch is content to believe that the Greek elements in the Sanskrit drama, the existence of which he demonstrates, were assimilated by the Indian authors through the agency of performances of Greek plays on the stage. It is not necessary, he says, to assume that the texts were known in India. It seems to me impossible that the resemblances between the Greek and Indian dramas should have been brought about in this casual way. It would be nearly as easy to believe that Aryabhata learned the signs of the zodiac and the term 'diameter' from chatting with ship-captains on the quays of Barygaza. I can see no reason whatever to feel sceptical about the reality of the diffusion to a limited extent of Greek books in Greek among the learned classes of India during the early centuries of our era.

The coins and the manuals of astronomy are incontrovertible evidence that some people there could read Greek, and why it should be supposed incredible that Kālidāsa could read the plays of Menander I cannot imagine.

We are not bound to accept as literal statements of fact the rhetorically expressed assertions of Plutarch and Dio Chrysostom that the Indians sang the poems of Homer, and that the children of the Gedrosians recited the tragedies of Euripides and Sophocles, and may yet feel full assurance that Indian scholars who studied and assimilated Alexandrian manuals of astronomy cannot have been altogether unacquainted with the classic literature of Greece.

I have now reached the bounds to which a general survey of the action of Hellenic influence on ancient India can be conveniently extended at present. The adequate discussion of the Gāndhāra sculptures alone would fill a goodly volume. The imperfect account of them given above is only intended to stimulate curiosity, and to indicate the directions in which more exhaustive investigation will reward the student.

I do not desire to exaggerate the intrinsic merit of these sculptures, though I feel assured that it is amply sufficient to justify their critical study, and that, even if it were much less than it is, the historical interest attaching to the productions of a school which links together Hellenic and Indian art gives them a right to claim the attention both of Orientalists and of classical scholars.

The discovery of the linguistic and literary treasures of Sanskrit so charmed the imagination of the earlier Orientalists that they lent

a ready ear to the extravagant tales of the pandits, and were willing to attribute the most venerable antiquity and almost absolute originality to the strange civilization and vast literature suddenly brought within their ken.

Modern historical and literary criticism has been steadily engaged in the task of exposing the falsity of Brahmanical tradition or pseudo-tradition, the "lying gabble of Bráhmans," as it has been well called, and of moving up, so to speak, all dates in the early history of India. Pápiní, the grammarian, Manu, the lawgiver, Kálidása, the poet and dramatist, and many other names famed in Indian story, have already been moved up from remote prehistoric, or pre-Christian, times to post-Alexandrian, or post-Christian, dates.*

This process still continues, and simultaneously with the demonstration of the comparatively modern date of all Śanskrit, other than Vedic, literature, the conviction has forced itself upon scholars that the civilization of ancient India was not so indigenous and self-contained as, at first sight, it seemed to be.

India may, apparently, claim with justice to have given birth independently to the mechanical process of coinage, but her weakly numismatic child never attained maturity, and was soon compelled to make way for a stranger of more vigorous growth. The other products of civilization claimed from time to time as independent Indian discoveries are now either proved to be foreign importations, or shown to be, at the best, of doubtful parentage.

I do not know any historical problem more startling at first sight than that propounded by the sudden and simultaneous first appearance in India during the third century B. C. of long documents in two diverse highly developed alphabets, of stone architecture, stone sculpture, chronological eras, inscribed coins, and a missionary state religion.

The problem has not yet been completely solved, and perhaps never can be, but it is certain that the phenomena referred to were largely due to a rapid development of intercourse between India and Western nations in the time of the Mauryan dynasty of Chandra Gupta and Aśoka (B. C. 315 to 222). A further development, or renewal, of that intercourse in the first century before, and the four centuries following, the Christian era, conducted through Bactrian, Alexandrian, and Palmyrene channels, produced new schools of architectural, plastic, and pictorial art, introduced novel types and standards of coinage, taught science in its exacter forms, and gave birth to a dramatic literature of great variety and merit.

* For a convenient summary of much of the recent discussion on the chronology of Indian Literature, see Max Müller's "India, What can it Teach Us?"

The same occidental influences left enduring marks on the religion and mythology of India, modified her epic poetry, and in the opinion of some competent judges, affected even the grammar, logic, and philosophy which are the most characteristic and original products of Indian thought.

The investigation of the relations between the early civilization of India and that of Western nations is still very incomplete, but it has proceeded sufficiently far to warrant the belief that further research will magnify rather than diminish the debt due by India to Assyria, Babylonia, Persia, Greece, and Rome.

ADDENDUM.

When compiling the Bibliographical List (*ante*, page 113) I omitted to notice the following papers:—

(1.) Indo-Grecian Sculptures from the N.-W. Frontier, by Major J. Abbott (with a Plate). *Proc. As. Soc. of Bengal* for 1854, page 394.

This communication briefly notices a large box of sculptures presented to the Society which were “dug from the site of a temple on the left bank of the Indus, called Kala, close below Ghazi Huzara. The winged female is from another old site at present called Shah ke Tere in Quatur. They are very inferior in grace and execution to those from Trans-Indus..... Those at Kala seem to have belonged to a Buddhist temple of small size, but very richly and elaborately sculptured, the material being black clay-slate.” The plate represents a head from Ráwalpindi.

(2.) Note on a small Indo-Greek Sculpture, by the same, *ibid.* for 1858, page 261. The figure described and presented to the Society is one of the Atlantean class, purchased from a native, who had found it in an old fort of the Yúsufzai at the foot of the mountains.

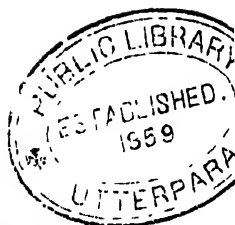
(3.) Account of some of the Sculptures in the Peshâwar Museum, by Rev. W. Loewenthal, *ibid.* for 1861, page 411.

The account given is, unfortunately, extremely meagre. It mentions Buddhas almost innumerable, kings of various sizes, a lady sitting on a lion, playing the lute, reliefs, and elaborate figures of warriors in

all kinds of dresses, sometimes purely Greek, sometimes purely Oriental, sometimes a mixture of the two.

The only work described in detail is the panel with the three Greek soldiers below, and grotesque figures above, which has been noticed in the text (*Section III, page 135*) Mr. Loewenthal states that this slab was "lately brought from Nagram in Yúsufzai by Lieut. Short." He observes that "some pieces of pottery have also been found in the cantonment [*scil.* Pesháwar], stamped with figures of pure Greek designs." I have not seen any such pottery.

JOURNAL
OF THE
ASIATIC SOCIETY OF BENGAL.



Part I.—HISTORY, LITERATURE, &c.

Supplement, for No. IV.—1889.

Catalogue of the Central Asiatic Coins, collected by Captain A. F. De Lasseo, in the Indian Museum, Calcutta.—By DR. A. F. RUDOLF HOERNLE.

(With two plates.)

The coins which are described in the subjoined catalogue were collected by Captain A. F. de Lasseo on the northern frontier of Afghánistán, in the years 1884 to 1886, during the time of the Afghán Boundary Commission, on which he was employed as Assistant Political Officer.

The coins were, under the orders of the Government of India, made over by him to Mr. Chas. J. Rodgers of the Archaeological Survey, for a preliminary examination and report. They were afterwards presented by the Government of India to the Indian Museum, with a request that duplicates, when available, should be given to the Museum in Lahore and to the British Museum in London.

At the request of the Trustees of the Indian Museum, the coins were carefully examined by me and catalogued. Mr. Rodgers' preliminary list proved of great advantage in this work, and most of his readings and many of his remarks are embodied in the following pages.

A large number of duplicates were presented to the Lahore Museum, and a somewhat smaller number to the British Museum. The numbers from which presentations could be made, are indicated by the marks † and ‡.

The collection will be found to be one of considerable interest. A large number of coins, especially of 'Aláu-d-dín Khwārizmī are either entirely new or, at least, have hitherto not been published. The most representative ones of these have been figured in the accompanying plates.



Abbreviations.

Ar. Ant. = Dr. Wilson's *Ariana Antiqua*; B. M. C. = British Museum Catalogue; Chron. = E. Thomas' *Chronicles of the Pathán kings of Delhi*; Ind. Ant. = Prinsep's *Indian Antiquities* (ed. Thomas); Int. Num. Or. = *International Numismata Orientalia*; J. A. S. B. = *Journal of the Asiatic Society of Bengal*; J. R. A. S. = *Journal of the Royal Asiatic Society of England*; Num. [Chron. = the *Numismatic Chronicle and Journal of the Numismatic Society of England*; Num. Or. = Marsden's *Numismata Orientalia*; Or. = *Oriental*; Sass. = E. Thomas' *Sassanians in Persia*.



Explanation.

- * prefixed, signifies that the coin is not noted in the existing British Museum Catalogue; † signifies that specimens of the coin have been sent to the British Museum; ‡ signifies that specimens have been sent to the Lahore Museum; g signifies that the coin is in good condition, f, t, i, that it is in fair, tolerable or indifferent condition respectively.

CATALOGUE.

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
ROMAN.							
1	1 ...	1 ...	...	...	...	42,60	Antoninus Pius. <i>Obv.</i> , head of emperor; ....NINUS AU..... <i>Rev.</i> , draped female seated on ground, to left. (i)
2	1 ...	...	...	1 ...	...	28,13	Constantius II. <i>Obv.</i> , head of emperor: CONSTANTIUS AUG. <i>Rev.</i> , standard between two armed soldiers: GLORIA EXERCITUS; in exergue SMANZ. (t)
GREEK.							
3	1 ...	1 ...	...	...	...	47,29	Alexander. Drachm. <i>Obv.</i> , head of king. <i>Rev.</i> , seated Zeus with eagle. (i)
4	1 ...	1 ...	...	...	...	55,83	Antiochus. Drachm. <i>Obv.</i> , head of king to right. <i>Rev.</i> , Heracles seated; to left [A]NTIOXO[Y], to right [BA]ΣILE[ΩΣ]. <i>A barbarous copy or forgery with a hole for suspension.</i> (t)
BACTRIAN.							
5	1 ...	1 ...	...	...	...	60,92	Eukratides. Drachm. <i>Obv.</i> , head of king; border of dots. <i>Rev.</i> , Dioscuri mounted; legend ΒΑΣΙΛΕΩΣ ΕΥΚΡΑΤΙΔΟΥ. Type like B. M. C., vol. V, 6. Rare. <i>This specimen is probably a forgery; the legend is smudged and "basileos" is double-struck. None in B. M. C. of 1886, but a specimen lately obtained from Gen. Sir A. Cunningham.</i>
6	1 ...	...	...	1 ...	...	133,92	Soter Megas. <i>Obv.</i> , bust of king. <i>Rev.</i> , horseman. Type like Ar. Ant., pl. IX, 12 (with no fillet to lance, and legend ΒΑΣΙΛΕΥ for βασιλευς.) (f)
INDO-SCYTHIAN.							
7	1 ...	...	...	1 ...	...	263,77	Kanishka. <i>Rev.</i> , OKPO. Type like Ar. Ant., pl. XII, 17. (t)




Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
INDO-SCYTHIAN— <i>Contd.</i>							
8	1 ...	...	1 ...	...	225.55	Oerki (OER). <i>Obv.</i> , elephant-rider. <i>Rev.</i> , MIOPO (?) Type like B. M. C., No. 153 (p. 155). (t)
9	1 ...	...	1 ...	...	168.05	Do. A crude variety of No. 8. Type like Ar. Ant., pl. XIII, 20. (t)
PARTHIAN.							
10	1 ...	1 ...	...	...	53.69	Mithridates I (ARSACES VI). Type a in Int. Num. Or., vol. I, pl. I, 26 (Gardner). (t)
11	1 ...	1 ...	...	...	56.94	† Sinatroces (ARSACES X). Type as in Int. Num. Or., vol. I, pl. III, 2. (g)
12	1 ...	1 ...	...	...	54.99	Orodes I (ARSACES XII). <i>Obv.</i> without crescent, as in Int. Num. Or., vol. I, pl. III, 20. (f)
13	1 ...	1 ...	...	...	59.22	† Do. <i>Obv.</i> with crescent, as in Int. Num. Or., vol. I, pl. III, 23. (f)
14	1 ...	1 ...	...	...	59.87	Do. <i>Obv.</i> with star and crescent, as in Int. Num. Or., vol. I, pl. III, 26. (f)
15	2 ...	2 ...	...	...	58.10	† Phraates IV (ARSACES XIII). <i>Obv.</i> with eagle only, as in Int. Num. Or., vol. I, pl. IV, 6. One has a loop attached to the middle of the <i>obv.</i> , to turn the coin into a button, and weighs 59.85 grains. (t)
16	1 ...	1 ...	...	...	60.86	Do. <i>Obv.</i> with eagle, crescent and star, as in Int. Num. Or., vol. I, pl. IV, 12. (t)
17	2 ...	...	...	2	58.93	† Do. <i>Obv.</i> with Nike, crescent and star, as in Int. Num. Or., vol. I, pl. IV, 11. Apparently a mixture of silver and copper. One is perforated for wearing, and weighs 57.46 grains. (i)
18	1 ...	...	...	1	56.30	Do. <i>Obv.</i> with eagle and crescent. <i>Rev.</i> with eagle. Not in Int. Num. Or.; but cf. vol. I, pl. IV, 6. Apparently a mixture of silver and copper. New. (i)
19	1 ...	1 ...	...	...	55.74	† Vonones I (ARSACES XVII). As in Int. Num. Or., vol. I, pl. V, 4. (f)



Serial Number	Number of Coins	METAL				Weight in grains	Description
		Gold	Silver	Copper	Mixed		

PARTHIAN— <i>Contd</i>							
20	1	1				56,44	† Goterzes (ARSACES XX) As in Int Num O ₁ , vol I, pl V, 20 (f)
21	3	3				55,14	† Artabanus IV (ARSACES XXVI) or Mithridates IV (ARSACES XXVII) As in Int Num O ₁ , vol I, pl VI, 5, 22, 24, 25 Two are perforated for wearing, weighing 55,14 (small hole) and 51,66 (big hole), the third is entire, weighing 52,25 grains (f, v, g) <i>The entire one has on the rev a trace of Mongol over striking</i>
22	1	1				54,66	Vologeses IV (ARSACES XXXI) As in Int Num Or, vol I, pl VII, 10 (t)
23	1	1				44,10	Artabanus V (ARSACES XXXIV) As in Int Num O ₁ , vol I, pl VII, 19 (v)
SUB-PARTHIAN							
24	1		1			85,02	Anonymous <i>Obv</i> , head of king, to right, with torques, as in the coins of ARSACES XXIX (CHOSROES) in Int Num O ₁ , vol I, pl VI, 17 <i>Rev</i> , fire-altar as on the early Sassanian coins in Sass, pl I, 2 Unpublished (v)
SASSANIAN							
25	1	1				63,20	Sapor I As in Sass, pl II, 2-6 With a perforation for wearing (t)
26	1		1			162,13	Do As in Sass, pl II, 8, 9 (t)
27	1		1			192,54	† Ardeshir and Sapor I As in Sass, pl I, 12 (v)
28	1	1				61,95	† Sapor II As in Sass, pl IV, 2, 3 (f)
29	1	1				49,54	Do Another variety As in Sass, pl IV, 4 (t)
30	1	1				62,42	† Firúz I As in Sass, pl V, 8, 9 (f)
31	1	1				62,26	Khusrú I , NAUSHÍRVÁN As in Sass, pl VI, 9 (g)

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
SASSANIAN— <i>Contd</i>							
32	2 ...	1 ...	...	...	62,44	† Khusrú II , PARWÍZ. As in Sass., pl. VI. 14. The less perfect one weighs only 53,01 grains. (<i>g</i>)
33	1 ...	1 ...	...	...	51,44	Do. Of Arab mintage with <i>bismillah</i> on margin; Sass., p. 93. Perforated for wearing. (<i>f</i>)
34	1 ...	1 ...	...	...	27,61	Yezdegird III. Small sized coin; not in Sass. <i>A very small piece broken away; otherwise in good condition.</i>
ABBASIDE.							
35	1 ...	1 ...	...	...	43,87	Al Mansúr , 2ND ABBASIDE. Dirham struck in Madínatu-s-Salám, 152 A. H. As in B. M. C., vol. I, 72 (p. 48). (<i>g</i>)
36	1 ...	...	...	1 ...	96,12	Do. Legends of obv. and rev. arcs, as in B. M. C., vol. I, 91 and 104 (p. 196, 201). Obv. margin not inscribed, but divided into three sections by three ringlets. Rev. marginal legend, indistinctly visible read by Mr. Rodgers <i>سجستان سنة سبع و اربعين</i> , i. e., struck in Sijistán, 147 A. H. (<i>i</i>)
37	1 ...	1 ...	...	...	37,34	Harún ar Rashíd , 5TH ABBASIDE. Dirham struck at Ma'adinu-sh-Shásh, 190 A. H. The same as B. M. C., vol. I, 228, (p. 84). With a loop for suspending. (<i>t</i>)
38	1 ...	1 ...	...	...	45,72	Al Amín , 6TH ABBASIDE. Dirham, struck at Madínat Balkh, 195 A. H. General type of coin exactly as B. M. C., vol. I, 246, (p. 90), except that there are six ringlets instead of five. (<i>f</i>)
39	1 ...	1 ...	...	...	29,50	Al Mutawakkil , 10TH ABBASIDE. Fragment (about $\frac{2}{3}$) of a dirham of 24* A. H. Mint lost. General type like B. M. C., vol. I, 317, (plate VI).
40	1	1 ...	...	...	54,38	* Al Muti'a , 23RD ABBASIDE. Dínár struck at Hirát, 369 A. H. (<i>f</i>) Plate I, fig. 1.

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
							<p>ĀBBASIDE—<i>Contd.</i></p> <p><i>Obv.</i>, small area within single circle, surrounded by double marginal inscriptions.</p> <p><i>Area</i> : لا اله الا الله وحده لا شريك له</p> <p><i>Inner legend</i> : بسم الله ضرب هذا الدينار بهرات سنة تسع وستين وثلثمائة</p> <p><i>Outer legend</i> : لله [الامر] من قبل و [من بعد و يومئذ يفرح] المؤمنون بنصر الله</p> <p><i>Rev.</i>, area within single circle, surrounded by one marginal inscription.</p> <p><i>Area</i> : الله محمد رسول الله العظيم الله نوح بن منصور ابوالفتح محمد الله</p> <p><i>Margin</i> : محمد رسول الله ارسله بالهدى [ودين الحق ليظهره على الدين كله] ولو كره المشركون</p> <p>SHAH OF KHWARIZM.</p>
41	1	1	...	...	...	36,87	<p>* 'Aláu-d-dín Muhammad bin Ta- kash. <i>Type</i> : on both sides, round areas sur- rounded by a marginal inscription between single-lined circles. Both margins defec- tive : but on <i>obv.</i>, mint Nisábúr legible ; date lost. (<i>t</i>) Plate I, fig. 2.</p>

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
							' SHAH OF KHWARIZM.—Contd.
							<p><i>Obv.</i> <i>Rep.</i></p> <p>   </p> <p> السلطان الاعظم على الدنيا والدين ابو المظفر تكش بن خراز زمشاه </p> <p> الله الله الله الله الله الله </p> <p><i>Margins:</i> fragmentary; <i>obv.</i> نيسا بور..... سنه</p>
42	1	1	...	...	...	33,57	<p>Do. Duplicate of No. 41, but double struck on both sides. Obverse margin fragmentary, showing only dato 5** ; reverse margin gone. (i)</p> <p><i>Obv. margin:</i> بسم الله خمس مائه</p>
43	1	1	...	...	...	44,37	<p>Do. Duplicate of No. 41; but struck on rev. side only, margin entirely gone. (i)</p>
44	2	2	...	...	...	26,95 16,08	<p>† * Do. <i>Type:</i> same as No. 41; but different reverse legend; and no ringlets on obv. Margins nearly gone. (i)</p> <p><i>Rev.</i> الله</p> <p> السلطان الاعظم على الدنيا والدين ابو الفتح محمد بن السلطان تكش </p> <p>  </p>
45	1	1	...	...	...	36,34	<p>Do. Duplicate of No. 44; but double struck on reverse side. Margins defective and illegible. (i)</p>
46	1	1	...	...	...	23,00	<p>† Do. Duplicate of No. 44; but struck on reverse side only. Margin nearly gone. (i)</p>

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
SHAH OF KHWARIZM—Contd.							
47	1	1	...	...	...	32,62	Do. Duplicate of No. 44; but double struck on rev. side, and struck on that side only. Margin gone. (t)
48	4	4	...	...	...	44,37	‡ Do. Duplicate of No. 44; but struck on obv. side only, on which there are no ringlets. One perforated specimen weighs 25,06; two others weigh 20,91 and 18,49 grains respectively. Margins defective and illegible. (i)
49	1	1	...	...	...	47,81	Do. Type: similar to No. 41, with reverse legend similar to No. 44; and on obv. side letters in place of ringlets. Both legends much blundered. Margins gone. (i)
		<i>Obv.</i>		<i>Rev.</i>			
							
		لا اله الا الله محمد		علا الدنيا والدين (sic)			
		الله رسو الله (sic)		ابو الفتح محمد			
		الناصر لله (sic)		طسو (broken).			
		.		ش (broken).			
		Mr. Rodgers reads فنك on rev.					
50	1	1	...	...	...	64,07	* Do. Two round areas with marginal inscriptions within single-lined circles, as in No. 41; but legends different, also characters different, i. e., nasta'liq, as in the early Pathán coins of India, not Kufic. One half of the coin is broken away. Reverse margin shows 6**. (i)
		<i>Obv.</i>		<i>Rev.</i>			
		..... لا		السلطان			
		..... محمد		ظم علا الله			
		..... الناصر		الفتح			
		..... امير الله		.....		
		<i>Rev. margin:</i> ستمائة					
		<i>Obv. margin:</i> الدين الحق					

Serial Number.	Number of Coins	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
51	18	...	...	...	18	35.58	<p>' SHAH OF KHWARIZM—<i>Contd.</i></p> <p>* † ‡ Do. <i>Type I</i>, obv., saddled horse with mint, within single-lined circle; sometimes three dots under horse; rev. inscription within singled-lined circle. One specimen was assayed by Dr. Scully with the result: copper 80.9 per cent., lead 13.5, silver 5.6. (<i>t</i>) Plate I, fig. 3. The mint is read by Mr. Rodgers <i>Balúqán</i> or <i>Talúqán</i>.</p> <p><i>Obv.</i> بلوفان Horse ∴</p> <p><i>Rev.</i> السلطان لا عظم علا لدنيا والدين محمد بن السلطان</p>
52	16	...	...	...	16	35.58	<p>* Do. <i>Type I</i>, similar to No. 51, same mint, but rev. legend differently arranged.</p> <p><i>Rev.</i> السلطان الاعظم علا لدنيا والدين محمد بن السلطان</p>
53	5	...	...	...	5	35.58	<p>* Do. <i>Type I</i>, similar to No. 51; same mint, but rev. legend differently arranged.</p> <p><i>Rev.</i> السلطان عظم علا نبا و الدين محمد بن السلطان</p>
54	1	...	...	...	1	34.44	<p>* Do. <i>Type I</i>. Apparently similar to No. 51, but double-struck on both sides. (<i>i</i>)</p>
55	4	...	...	...	4	37.89	<p>* † ‡ Do. <i>Type II</i>. Obv., horseman with lance at charge; <i>Variety 1</i>, semicircle over head of rider; some dots here and there; name of mint above right of rider. Rev., inscription only. Both obv. and rev. en-</p>

Serial Number	Number of Coins	METAL				Weight in grains	Description
		Gold	Silver	Copper	Mixed		
							<p>SHAH OF KHWARIZM—<i>Contd</i></p> <p>closed within double circle, the inner lined, the outer dotted Mint <i>Tāliqan</i> both - on obv and rev (2) Plate I, fig 4.</p> <p><i>Obv</i> <i>Rev</i></p> <p>طالقان طالقان (in minute letters)</p> <p>السلطان } or السلطان لاعظم علا الد بنا و الدس محمد بن السلطان</p> <p>Occasionally the rev legend is arranged, as on No 51</p> <p>* † ‡ Do Type II, <i>Variety</i> 2, in all respects like No 55 except that there is a bird to right below horse, instead of the dots. (t)</p> <p>* Do Type II, <i>Variety</i> 3, similar to No 55, but without semicircular coronet, and a tictail in the place of the bird Inscriptions on obv and rev exactly as on No 55 (t)</p> <p>* † ‡ Do Type II, <i>Variety</i> 4, bow-like canopy over head of rider, crescent above over left side, and mint above over right side of rider Rev, inscription Both obv and rev enclosed within double circle, the inner lined, the outer dotted Mint سغو (Shafūrgan ?) or سلو (t)</p> <p><i>Rev</i> السلطان الاعظم علا الدنيا و الدس محمد بن السلطان</p> <p>* Do Type II, <i>Variety</i> 5, similar to No 53, but bare head, crescent with dot to left and dot to right of it Rev, inscription exactly as on No 58 Both obv and rev enclosed within a single-lined circle Mint سلو or سغو ? (2)</p>
56	4			4		39,74	
57	1			1		41,00	
58	2			2		39,78	
59	2			2		33 60 36,37	

Serial Number	Number of Coins	METAL				Weight in grams	Description
		Gold	Silver	Copper	Mixed		
							' SHAH OF KHWARIZM— <i>Contd</i>
60	1	.	.	.	1	40,09	* Do Type II, Variety 6, similar to No 59, but without crescent and dots, and with some indistinct object below horse. Rev inscription as on No 58 (i)
61	8				8	42,06	* † ‡ Do Type II, Variety 7, similar to No 58, but only with bow-like canopy. Rev, inscription as on No 58, but below it an illegible mint-name. Both obv and rev either within a single serrated circle, or within a double circle, the inner lined, the outer dotted (i)
62	2				2	27,36	* Do Type III Obv, horseman with waving arms, without lance. Variety 1, bird sitting to left below horse. Rev, inscription, nearly obliterated. Obv and rev within double lined circle (b)
63	2				2	34,42	* † ‡ Do Type III, Variety 2, like No 62, but bird turned to right. Mint <i>Talagán</i> , visible on obv over right side of horse (i)
64	3				3	37,09	* † ‡ Do Type III, Variety 3, a beetle-like mark under horse, mint over right side of horse. Rev, inscription. Both obv and rev enclosed within double-lined circles. Mint <i>Talagán</i> both on obv and rev. Legends, on both sides, read and are arranged exactly as on No 55 (i)
65	16				16	35,97	* † ‡ Do Type III, Variety 4, a star, 5 or 6 rayed, under horse, mint over right of horse. Rev, inscription. Obv enclosed within double circle, the inner lined, the outer dotted, rev within single-lined circle. Mint <i>Talagán</i> both on obv and rev. Legends as on Nos 55 and 63. Plate I, fig 5 (Some t)
66	2				2		* Do Type III, Variety 5, in all respects like No 65, except the rev legend which reads as follows (t) طالعان (in minute letters) السلطان الا عظم بن السلطان

Serial Number	Number of Coins	METAL				Weight in grains	Description
		Gold	Silver	Copper	Mixed		
SHAH OF KHWARIZM—Contd							
67	2				2	34,55	* Do Type III, Variety 6, like No 64 in all respects, except the mark under the horse which looks like an anvil (P) (i, b)
68	1				1	41,28	* Do Type III, Variety 7, like No 65 except that the mark under the horse is a snake, and the rev legend arranged as on No 52 (t)
69	2				2	36,52	* † ‡ Do Type III, Variety 8, like No 62, except that there is no mark under the horse (b)
70	2				2	.	* Do Type III, Variety 9, no mark under horse, which is galloping Both obv and rev enclosed within double circle, the inner lined, the outer dotted Rev legend as follows (i) [السلطان] (cut away) الا عظم ابو الفتح محمد بن السلطان
71	1				1	41,91	* Do Type IV Obv, horseman with leafed branch in left hand Mint doubtful over left side of horse, and bird under horse Both obv and rev enclosed within double circle, the inner lined, the outer dotted Plate I, fig 6 (t) Obv رميداور (P) Rev السلطان الا عظم ابو الفتح محمد بن السلطان
72	5				5	47 25	* † ‡ Do Type V, horseman with shouldered sword Variety 1, bare head, mint over right side of horse, below it a flower Rev, inscription Mint Hvrat Both obv and rev within three circles, a dotted one between two lined ones Plate I, fig 7 (t)

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
SHAH OF KHWARIZM—Contd.							
							<i>Obv.</i> هراة <i>Rev.</i> السلطان or السلطان الا عظم محمد بن rare- الا عظم محمد السلطان ly بن السلطان
73	6	...	...	6	45,38		* † ‡ Do. <i>Type V, Variety 2</i> , like No. 72, except that there is no flower below the horse. (i)
74	3	...	...	3	35,52		* † ‡ Do. <i>Type V, Variety 3</i> , like No. 73, but the mark under horse indistinguishable; canopy over head of rider and mint Balkh بلخ (?) (i)
75	6	...	...	6	46,72		* † ‡ Do. <i>Type VI, Obv.</i> , horseman with shouldered flag; bare head; no mint. <i>Rev.</i> , inscription in Kufic characters. Both obv. and rev. enclosed within three circles, a dotted one being between two lined ones. Plate I, fig. 8. One specimen was assayed by Dr. Scully with the result: copper 2·2 per cent., silver 7·4, lead 85·4. (t) <i>Rev.</i> محمد بن السلطان نکش
76	7	...	...	7	36,88		* † ‡ Do. <i>Type VII</i> , bare elephant to left. <i>Variety 1, Obv.</i> , a saw-like mark below, and a mint-name above elephant. <i>Rev.</i> , inscription. Both obv. and rev. within double circle, the outer dotted, the inner lined. One specimen was assayed by Dr. Scully with the result: per cent. copper 39·2, silver 8·0, lead 52·7. (i)
77	16	...	...	16	41,23		<i>Obv.</i> سمرقند (?) <i>Rev.</i> as on No. 58. * † ‡ Do. <i>Type VII, Variety 2</i> , similar to No. 76, but no mark below elephant, and mint and inscription different. (t)

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
							SHAH OF KHWARIZM— <i>Contd.</i>
							<i>Obv.</i> <i>Rev.</i>
							خانروان (P) as on No. 66.
							(but without the mint).
78	1	.....	.....	.....	1	34,50	* Do. Type VII, Variety 3, similar to No. 77, but different mint and inscription. (i)
							<i>Obv.</i> <i>Rev.</i>
							کرپروان (?) apparently as in No. 58.
79	3	.....	.....	.....	3	34,50	* Do. Type VII, Variety 4, similar to No. 77, but different mint and inscription. (i)
							<i>Obv.</i> <i>Rev.</i>
							شغورقان as on No. 52.
							[<i>Shufúrgán.</i>]
80	3	.....	.....	.....	3	34,50	* † ‡ Do. Type VII, Variety 5, similar to Nos. 77, 79, but different mint and inscription (2 i, 1f). Plate I, fig. 9.
							<i>Obv.</i> <i>Rev.</i>
							سلورقان (P) السلطان
							الا عظم علا
							الدنيا والدين
							محمد سلطان
81	3	.....	.....	.....	3	32,13	* † ‡ Do. Type VII, Variety 6, similar to No. 76; but the mark below is an arabesque; the mint above is the same without the final s; rev. inscription different. (i)
							<i>Obv.</i> <i>Rev.</i>
							سمر or سمر السلطان
							(Samarqand?) ن الا عظم علا
							الدنيا والدين
							محمد بن سلطان
							N. B. What looks like a mint name, may be only an arabesque ornamental mark.

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
SHAH OF KHWARIZM—Contd.							
82	4	.....	.....	.....	4	33,01	<p>* † ‡ Do. <i>Type VII, Variety 7</i>, similar to No. 81, but arabesque mark above and three dots in line below elephant. Rev. inscription different; viz., (t)</p> <p>السلطان ن الا عظم علا الدنيا والدين</p>
83	19	.....	.....	.....	19	33,58	<p>* † ‡ Do. <i>Type VII, Variety 8</i>, exactly as No. 82, but a different rev. inscription. (3 f)</p> <p>Rev.</p> <p>السلطان السلطان الا عظم علا or لا عظم علا الدنيا والدين (on one) الدنيا والدين محمد بن سلطان محمد بن سلطان</p>
84	14	.....	.....	.....	14	35,32	<p>* † ‡ Do. <i>Type VIII, bare elephant to right. Variety 1</i>, obv., mint above elephant; rev., inscription. Both obv. and rev. within double circle, outer dotted, inner lined. (i or b)</p> <p>Obv. (both in Kufic) Rev. كربوان السلطان (similar to No. 78) الا عظم علا الدنيا والد ين محمد بن سلطان</p>
85	3	.....	.....	.....	3	35,32	<p>* Do. <i>Type VIII, Variety 2</i>, exactly as No. 84, but style of letters of obv. mint somewhat different. (1 t). Plate I, fig. 10.</p>
86	4	.....	.....	.....	4	35,32	<p>* Do. <i>Type VIII, Variety 3</i>, exactly as No. 84, but style of letters of obv. mint slightly indifferent. (i)</p>

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.												
		Gold.	Silver.	Copper.	Mixed.														
SHAH OF KHWARIZM—Contd.																			
87	3	3	38,91	<p>* Do. <i>Type IX</i>, bare elephant to right, with fettered legs. <i>Variety 1</i>, obv., mint over elephant; rev., inscription. Both obv. and rev. within double circle, the outer dotted, the inner lined. (1 f). Plate I, fig. 11.</p> <table><tr><td><i>Obv.</i></td><td><i>Rev.</i></td></tr><tr><td>کربوان</td><td>السلطان</td></tr><tr><td>(as on No. 85)</td><td>الا عظم علا</td></tr><tr><td></td><td>الدنيا والدين</td></tr><tr><td></td><td>محمد بن</td></tr><tr><td></td><td>سلطان</td></tr></table>	<i>Obv.</i>	<i>Rev.</i>	کربوان	السلطان	(as on No. 85)	الا عظم علا		الدنيا والدين		محمد بن		سلطان
<i>Obv.</i>	<i>Rev.</i>																		
کربوان	السلطان																		
(as on No. 85)	الا عظم علا																		
	الدنيا والدين																		
	محمد بن																		
	سلطان																		
88	12	12	38,91	<p>* † ‡ Do. <i>Type IX, Variety 2</i>, exactly as No. 87, but style of letters of obv. mint slightly different. (<i>i</i>, some <i>t</i>)</p> <table><tr><td><i>Obv.</i></td><td><i>Rev.</i></td></tr><tr><td>کربوان</td><td>(as on No. 87).</td></tr><tr><td>(as on No. 85.)</td><td></td></tr></table>	<i>Obv.</i>	<i>Rev.</i>	کربوان	(as on No. 87).	(as on No. 85.)							
<i>Obv.</i>	<i>Rev.</i>																		
کربوان	(as on No. 87).																		
(as on No. 85.)																			
89	12	12	38,91	<p>* † ‡ Do. <i>Type IX, Variety 3</i>, similar to No. 88, but inscription different. (<i>i</i>, one <i>t</i>)</p> <table><tr><td><i>Obv.</i></td><td><i>Rev.</i></td></tr><tr><td>کربوان</td><td>(as on No. 84.)</td></tr><tr><td>(as on Nos. 89, 84.)</td><td></td></tr></table>	<i>Obv.</i>	<i>Rev.</i>	کربوان	(as on No. 84.)	(as on Nos. 89, 84.)							
<i>Obv.</i>	<i>Rev.</i>																		
کربوان	(as on No. 84.)																		
(as on Nos. 89, 84.)																			
90	2	2	38,91	<p>* Do. <i>Type IX, Variety 4</i>, exactly as No. 89, but style of letters of obv. mint slightly different. (<i>i</i>)</p> <table><tr><td><i>Obv.</i></td><td><i>Rev.</i></td></tr><tr><td>کربوان</td><td>(as on Nos. 84, 89).</td></tr><tr><td>(as on Nos. 85, 87).</td><td></td></tr></table>	<i>Obv.</i>	<i>Rev.</i>	کربوان	(as on Nos. 84, 89).	(as on Nos. 85, 87).							
<i>Obv.</i>	<i>Rev.</i>																		
کربوان	(as on Nos. 84, 89).																		
(as on Nos. 85, 87).																			

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
91	1					42.81	<p>SHAH OF KHWARIZM—<i>Contd.</i></p> <p>* Do. <i>Type X</i>, elephant-rider with lance at charge, to left. <i>Variety 1</i>, obv., mint below elephant; rider bare-headed. Rev., inscription. Both obv. and rev. within double circle, outer dotted, inner lined. (<i>t</i>) Plate I, fig. 12.</p> <p><i>Obv.</i> <i>Rev.</i> السلطان ن الأعظم علا الدنيا والدين محمد بن سلطان ن</p>
92	1					38.43	<p>* † Do. <i>Type X</i>, <i>Variety 2</i>, similar to No. 91, but on obv. no mint; bow-like canopy over rider's head; dot over elephant's head; rev. legend different. (<i>i</i>) Plate I, fig. 13.</p> <p>Rev. legend, as on No. 83.</p>
93	20. ..					47.58 45.11	<p>† Do. <i>Type XI</i>, lettered surfaces, within circles. <i>Variety 1</i>, as in B. M. C., vol. II, Nos. 596—600 (see Plate VII, fig. 599). (<i>t</i>, some <i>f</i>)</p>
94	1					34.92	<p>Do. <i>Type XI</i>, <i>Variety 2</i>, as in B. M. C., vol. II, No. 594. (<i>t</i>)</p>
95	3. .					43.25	<p>* † Do. <i>Type XI</i>, <i>Variety 3</i>. Obv. and rev. within double circle, outer dotted, inner lined. On obv., two annulets on each side of the inscription; also on rev. in diverse places. (<i>i</i>)</p> <p><i>Obv.</i> <i>Rev.</i> محمد بن السلطان نكش : الأعظم : ابو الفتح</p>

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
SHAH OF KHWARIZM.—Contd.							
96	1 ...	...	1 ...	...	42,42	Do. <i>Type XI, Variety 4.</i> Obv., kalimah; rev. illegible. (i)	
97	2 ...	...	2 ...	...	41,11 37,00	* ‡ Do. <i>Type XII, small inner circular area on obv.; lettered surface on rev.; both rev. and obv. within double circle, outer dotted, inner lined. Variety, 1, Muḥammad in Kufic in area, with dot above. Plate I, fig. 14. (t)</i>	
<div>Obv.<div>Rev.</div></div>							
<div>Area : محمدالسلطان الا</div>							
<div>Margin : لا اله الا اللهعظم علا الد</div>							
<div>الناصرleftنيا والدين محمد</div>							
<div>(sic) رسول اللهbelowبن السلطان</div>							
<div>اللهright.</div>							
98	1 ...	...	1 ...	...	52,53	* Do. <i>Type XII, Variety 2, inner area formed by a double circle; within, an illegible mint name. (i)</i>	
<div>Obv.<div>Rev.</div></div>							
<div>Area : ع...ابو</div>							
<div>Margin :الفتح محمد</div>							
<div>السلطان الاعظمبن السلطان</div>							
<div>علا الدنيا والديننكش</div>							
99	3 ...	...	3 ...	...	44,88	* Do. <i>Type XII, Variety 3, inner area formed of three circles, a dotted between two lined; within, a sexagonal rose or star. Published by W. Rodgers in J. A. S. B. vol. LII (1883), p. 57, No. 15 on Plate IV. (i)</i>	
100	1 ...	...	1 ...	...	47,60	* Do. <i>Type XII, Variety 4, like No. 99 in every respect, except that rev. legend differently arranged. (i)</i>	

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
							SHAH OF KHWARIZM.— <i>Contd.</i>
							<p>Rev. ابو الفتح بن السلطان [نكش] (<i>lost</i>)</p>
101	3	8 ...				45,37	<p>* † Do. <i>Type XIII</i>, a small inner circular area on both obv. and rev.; the latter are both surrounded by a double circle, outer dotted, inner lined. <i>Variety 1</i>, both inner areas formed by three circles, a dotted between two lined; within, mint <i>Zamin-dáwar</i>. (<i>i</i>) Plate I, fig. 15 <i>a</i> and <i>b</i>.</p> <p>Obv. Rev.</p> <p>Margin: ابو الفتح بن السلطان الا عظم علا : Margin: السلطان نكش الدنيا والدين</p> <p>Area : داور Area : ز ميين</p>
102	1	1 ...				38,60	<p>* Do. <i>Type XIII, Variety 2</i>, like No. 100 in every respect, except that the circles forming the inner area are wider apart from one another, thus causing the margin to be narrower. Legends as in No. 101. (<i>i</i>)</p>
103	2	2 ...				41,99	<p>* Do. <i>Type XIII, Variety 3</i>, obv. area formed by two lined circles; rev. area by three circles, a dotted between two lined; within both areas a boss. (<i>i</i>)</p> <p>Obv. Rev.</p> <p>Marg.: ابو الفتح محمد بن السلطان الا عظم علا : Marg.: السلطان نكش الدنيا والدين</p> <p>Area : boss Area : boss</p>
104	1	1 ...				52,08	<p>* Do. <i>Type XIV</i>, two-lined square areas occupying whole of obv. and rev. faces; segments inscribed. Almost illegible. (<i>i</i>)</p>

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
SHAH OF KHWARIZM.—Contd.							
107	2....			2...		44,24	* Do. <i>Type XVI</i> , on both obv. and rev., two hexagonal areas intercrossing, with three dots in each section. Mint Farwán. Published by W. Rodgers in J. A. S. B., vol. LII, p. 57, on Plate IV, fig. 12.
108	1....			1...		40,65	Do. <i>Type XVII</i> , obv., lettered surface within double circle, outer dotted, inner lined. Rev., small double-lined square inner area; within, figure of horseman, outside inscription. As in B. M. C. of Or. Coins, vol. II, p. 186, on Plate VII, fig. 603. (i)
109	1....			1...		57,17	* † Do. <i>Type XVIII</i> , large thin piece obv., circular area; rev., double-lined square area. In marginal sections, apparently, mint Ghaznah. Plate II, fig. 17. (i)
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p><i>Obv.</i></p> <p>Area: السلطان الا عظم علا الدنيا والدين ابو لفنج</p> <p>Margin: Orna- ments.</p> </div> <div style="width: 45%;"> <p><i>Rev.</i></p> <p>Area: السلطان بن سلطان امير المومنين</p> <p>Sections: ornmt., r. and l. above. عزبه below.</p> </div> </div>							
110	1....			1		43,50	* Do. Doubtful. <i>Type XIX</i> ; obv., horseman to right, with lance at charge, within double circle, outer dotted, inner lined. Rev., inscription within single dotted circle; nearly illegible. Mr. Rodgers observes: "This is the only coin out of about 3,000, which has the horseman to the right."

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
SHAH OF KHWARIZM.—Contd.							
111	1 ...	...	1 ...	...	...	34,85	<p>* Do. doubtful. <i>Type XX</i>; obv., maned lion standing to left, below a شاه above mint <i>Shafûrqân</i>. Rev., inscription within lined circle, nearly obliterated.</p> <p><i>Obv.</i> شہر قان <i>Rev.</i> سلطان</p>
GHAZNAWIS AND GHORIS, ETC.							
112	1 ...	...	1 ...	...	...	58,63	<p>Masa'ûd I. Two circular areas and margins, as in B. M. C. of Or. Coins, vol. II, No. 524 (p. 157), but barely legible. (i)</p>
113	1 1 ...	...	...	...	...	82,70	<p>* Farukhzâd ibn Masa'ûd. Similar to No. 546 in B. M. C. of Or. Coins, vol. II, p. 166; but star 'six-rayed' at top of rev. area, and <i>zafar</i> (ظفر, so W. Rodgers) at top of obv. area; date 448; the remainder identical. The outer marginal legend of obv. is nearly gone; that on reverse much cut and obliterated. (f)</p>
114	1 ...	...	...	...	1	45,56	<p>Ibrâhîm ibn Masa'ûd; with Bull rev., and lettered surface on obv., as in B. M. C. of Or. Coins, vol. II, No. 561 (p. 172), and in Proceedings, A. S. B., for 1881, p. 6. (i)</p>
115	1 ...	...	...	1 ...	...	45,69	<p>Undetermined. Probably Ghaznawî. Legends illegible; but on right hand side of the legend in the area, there is a perpendicular mark, which is indistinguishable on the obv., but clearly $\frac{1}{2}$ on the rev. Compare similar marks on Maḥmûd's coin, Pl. V, No. 458 in B. M. C., vol. II, p. 131. (i)</p>
116	1 1 ...	...	...	...	...	41,55	<p>* Ghiyâsu-d-dîn Muhammad bin, Sâm. Two circular areas; both margins entirely obliterated.</p>

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
							GHAZNAWIS AND GHORIS.— <i>Contd.</i>
							<div> <div>Obv.</div> <div>Rev.</div> </div> <div> السلطان الا عظم عبات الدنيا والدين ابو المظفر محمد بن سام حسلو (P) (illegible) </div> <div> لا اله الا الله محمد رسول الله الناصر الدين </div>
117	1	1	...	...	...	267,35	<p>Mr. Rodgers reads on the obv. doubtfully قشلو or حسلو. Plate II, fig. 18.</p> <p>Do. Same type, but much heavier, than No. 6 in J. A. S. B., vol. LII, p. 56 (Pl. IV, fig. 6). Without mint; but date 600 A. H. The rev. margin, as Mr. Rodgers observes, gives a quotation from the Qurán, Surah IX, 33,</p> <p>هو الذي ارسل رسوله بالهدى ودين الحق ليظهره على الدين كله [ولو كره المشركون]</p> <p>the concluding portion of which, viz. that within brackets, is never given on these gold coins. (g)</p>
118	1	1	...	...	...	232,80	<p>* Do. Very similar to No. 117, but with mint Ghaznah, and same date 600 A. H. (g)</p>
119	1	1	...	...	...	134,73	<p>* Do. The same as No. 117, except in the matter of weight; also without mint. Its date is 600 A. H. (f)</p>
120	1	1	...	...	...	181,51	<p>Do. Same type, as No. 117, but of smaller size; date 603 A. H., mint obliterated (Ghaznah?). (t)</p>
121	1	1	...	...	...	122,76	<p>Do. Same as No. 120, except in the matter of weight. Mint Ghaznah; date obliterated (600?).</p>
122	2	...	...	...	...	43,86 42,78	<p>Do. Type: Turkí horseman, exactly as published, by Mr. Rodgers, in J. A. S. B., vol. LII, p. 55 (Pl. IV, fig. 1.) (1 t)</p>

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
GHAZNAWIS AND GHORIS—Contd.							
123	2	...	...	...	2	56,68 45,45	Do. Doubtful. Inscribed circular areas. <i>Obv.</i> <i>Rev.</i> سلطان لاعظم ع [دات] ... ضرب
124	1	1	...	...	...	116,13	* Ghiyásu-d-dín and Muizzu-d-dín bin Sâm. Type the same as in No. 117. A silver coin of this type has been published by Dr. Stülpnagel in J. A. S. B., vol. XLIX, p. 31 (Pl. IV, No. III). It shows no mint, but bears the date 599 A. H. (f)
125	1	1	...	...	...	45,72	* Do. Type, four concentric circles, exactly as in the silver dirhem, published by Dr. Stülpnagel, in J. A. S. B., vol. XLIX, p. 30 (Pl. IV, No. II). No mint; but date 599 on the rev. with Muizz' name. (t)
126	2	...	...	...	2	45,95 42,52	Muizzu-d-dín and Táju-d-dín Ildaz. Published by Mr. Rodgers, in J. A. S. B., vol. XLIX, p. 210 (Pl. XVIII, No. 17). See also Ar. Ant. Pl. XX, fig. 18. (t)
127	1	...	...	...	1	50,96	‡ Muizzu-d-dín bin Sâm. Type, Turkí horseman; exactly as in Chron., p. 15, No. 6 (Pl. I, fig. 5). (t)
128	1	...	...	...	1	48,19	Do. Type, Rájput horseman; exactly as in Chron., p. 15, No. 5, (Pl. I, fig. 4). (t)
129	7	...	...	...	7	55,06	‡ Do. Type, bull and horseman, exactly as in Chron., p. 15, No. 10, (Pl. I, fig.). (t)
130	1	...	...	...	...	37,44	* Do. Type, on both obv. and rev., an inscribed hexagon formed by two interlacing equilateral triangles. (t) <i>Obv.</i> <i>Rev.</i> السلطان (P) محمد بن سام

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
GHAZNAWIS AND GHORIS—Contd.							
131	1	...	...	1	...	43,51	<p>Do. <i>Type</i>, circular areas, enclosed in dotted ring, exactly as published, by Mr. Rodgers, in J. A. S. B., vol. XLIX, p. 81, (Pl. V, fig. 6). (t)</p> <p><i>Obv.</i> عدل <i>Rev.</i> معز</p>
132	1	...	...	...	1	47,85	<p>‡ Ghiyāsu-d-dīn Mahmūd bin Muhammad bin Sām. <i>Type</i>, Rājput horseman, exactly as in Chron. p. 32, No. 25, and Journal R. A. S., vol. IX, p. 177.</p>
133	1	...	...	...	1	40,59	<p>* † Do. <i>Type</i>, elephant rider to left. <i>Variety</i> 1, similar to No. 91, but without lance at charge; with goad (<i>ankus</i>) in right hand. Plate I, fig. 19. (f)</p> <p><i>Rev.</i> السلطان الا عظم غيا ث الدنيا والدين ابوالفتح محمو د بن محمد سام</p>
134	1	...	...	1	...	38,85	<p>* Do. <i>Variety</i> 2, the same as No. 133 in all respects, except slightly different arrangement of rev. inscription. (i)</p> <p><i>Rev.</i> السلطان الا عظم غياث الدنيا والدين ابوالفتح محمو [د بن محمد سام] lost.</p>
135	1	...	...	1	...	42,06	<p>* Do. <i>Variety</i> 3, similar to No. 133; but bow-like canopy over rider, and slightly different rev. inscription. (i)</p> <p><i>Rev.</i> السلطان ن الا عظم غيا ث الدنيا والدين محمود بن محمد سام } much worn.</p>


Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
GHAZNAWIS AND GHORIS— <i>Contd.</i>							
136	1		1	...		37,10	* † ‡ Do. <i>Variety 4</i> , similar to No. 133, but with lance at charge, and somewhat different rev inscription. (<i>f</i>) <i>Rev.</i> السلطان الاعظم ابو الفتح محمود بن محمد سام
137	1		1			51,18	Táju-d-dín Ildaz. <i>Type</i> , Turkí horseman, as published by Mr. Rodgers, in J. A. S. B., vol. LII. p 55 (Pl. IV, fig. 2). (<i>t</i>)
138	5		5			51,05	‡ Do. <i>Type</i> : Rájput horseman, as in Ar. Ant., Pl. XX, fig. 9. (<i>t</i>)
NISABURI AMIRS.							
139	1	1		....		31,24	‡ Tughán Sháh. Circular areas with inscribed margins, as in B. M. C. of Or. Coins, vol III, No. 313 (Pl. VI, fig. 313). Mint obliterated, date 57*. (<i>t</i>) <i>Obv. margin</i> : بسم الله وسبعين خمسمائة
140	1	1		...		26,15	‡ Do. Same type as No. 139, but otherwise as in B. M. C. of Or. Coins, vol. III, No. 314. Mint and date lost. (<i>i</i>)
BENI ZENGI ATABEGS OF MOSIL.							
141	1	1	..	....		87,23	* Badru-d-dín Lúlú. Mint Mosil, date 650; in every respect like No. CLXXX in Num. Or., p. 170, (Pl. X). It differs from B. M. C., vol. III, No. 574 (Pl. X) only in the omission of the word وسلم in the second line of the rev. area inscription, and in the date. (<i>g</i>)
GREAT SELJUQS.							
142	1	..	..	1	...	48,36	Muhammad. Lettered surfaces, enclosed within double lined circles. The obv. is marked with <i>fath</i> , the rev. with

Serial Number	Number of Coins	METAL				Weight in grams	Description
		Gold	Silver	Copper	Mixed		
							<p>GREAT SELJUQIS—Contd</p> <p>'adl, as in B M C, vol III, No 67, p 34, 35 (2)</p> <p>Obv فتح لا اله الا الله محمد [رسول الله]</p> <p>Rev عدل</p> <p>Rest illegible</p>
143	1		1			42.58	<p>RUMI SELJUQIS</p> <p>Ghiyásu-d-dín Kai-Khusrú II <i>Type:</i> obv, sun over lion to right, rev inscription, exactly as in B M C of Or Coins, vol III, No 225 With a small hole near the margin for wearing (g)</p>
144	4			4		27.20	<p>MALIKS OF SIJISTAN</p> <p><i>N B On these Maliks, see Major Raverty's translation of the Tabagát-i-Násirí, pp 183-202</i></p> <p>† Ahmad bin Muhammad As described and figured in B M C of Or Coins, vol III, No 34, (1 f, another broken in fragments)</p>
145	1			1		29.01	<p>* † Khalaf ibn Ahmad <i>Type</i> circular areas with inscribed margins, on both obv and rev The coin is in indifferent condition, and the legends difficult to read Mr Rodgers remarks as follows</p> <p>"Obv خلق under بن احمد in tughrá</p> <p>Rev etc اميرة الامير ابو جعفر</p>
146	18			18		51.81 43.66	<p>Margins not quite legible, but the mint Sijistán is quite plain "</p> <p>† † Táju-d-dín Harab, sixth in descent from Khalaf <i>Type</i> obv, quarter-foil within double-lined circle, one pellet in each segment, rev, lettered surface within three circles, the inner and</p>




Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
MALIKS OF SIJISTAN—Contd.							
							outermost lined, the central dotted. Plate II, fig. 20. (f)
							<div><div>Obv.</div><div>تاج حرب بن محمد الدين</div></div> <div><div>Rev.</div><div>الله محمد رسول الله الناصر الدين محمد</div></div>
							The obv. reads: <i>Tāju-d-dīn Harb bin Muḥammad.</i>
147	1			1 ...	59,40		† * Ruknu-d-dīn Bahrām Sháh , grandson of Tāju-d-dīn. <i>Type</i> , obv. and rev., lettered surfaces within double circles, inner dotted, outer lined. Plate II, fig. 21. (t)
							<div><div>Obv.</div><div>ركن الدين ابو منصور بن بهرامشاه</div></div> <div><div>Rev.</div><div>الله محمد رسول الله الناصر الدين</div></div>
148	16			16 ...	52,46 59,90		† † Tāju-d-dīn Nasar bin Bahrām Sháh . <i>Type</i> , same as No. 146.
							<div><div>Obv.</div><div>تاج نصر بن بهرامشاه الدين</div></div> <div><div>Rev.</div><div>The same as on No. 146, but omitting final محمد.</div></div>
							<i>Apparently identical with Naṣratu-d-dīn, another grandson of Tāju-d-dīn.</i>

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
149	3	...	...	3	...	51,66 51,22 44,72	<p>MALIKS OF SIJISTĀN—Contd.</p> <p>* † ‡ Asadu-d-dīn bin Harab. <i>Type,</i> same as No. 146. (<i>t</i>)</p> <p><i>Obv.</i> <i>Rev.</i> عصده الله ابوالمظفر محمد ابن حرب رسول الله الدين الناصر الدين</p> <p><i>Not mentioned in Major Raverty's list.</i></p>
150	6	...	...	6	...	39,14	<p>* † ‡ Undetermined. <i>Obv., circular</i> area with marginal inscription; <i>rev.</i> lettered surface within lined circle. (<i>one t</i>) Plate II, fig. 22.</p> <p><i>Obv.</i> <i>Rev.</i> Area : ∴ (illegible.). حرب لا لله الا الله Margin : illegible. محمد رسول الله الناصر الدين الله محمد</p>
151	1	...	...	1	...	40,82	<p>* Undetermined. <i>Obv.</i> worn blank; <i>rev.</i> shows only الناص, and traces of م, over it. (<i>b</i>)</p>
152	1	1	...	...	...	50,21	<p>MONGOL IL-KHANS OF PERSIA.</p> <p>* Undetermined. Circular areas with inscribed margins, on both <i>obv.</i> and <i>rev.</i> The margins are nearly gone, and the areas are much worn. Date *77. The legends as read by Mr. Rodgers, are as follows :</p> <p><i>Obv.</i> <i>Rev.</i> خان لله الخاقان العادل لا اله الا الا عظم الله محمد رسول الله ارسلان امام المسلمين <i>Rev. margin :</i> سبع و سبعين.....</p>

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
							MONGOL IL-KHANS OF PERSIA.
153	1 1 ...					63,52	<p>‡ Jingis Khán. <i>Type:</i> lettered surfaces within double circle, the outer dotted, the inner lined, on both obv. and rev. (<i>t</i>)</p> <p><i>Obv.</i> <i>Rev.</i> عدل الناصر خاقان لدين الله الا عظم اميرالمو منين</p>
154	1 ... 1					46,15	<p>* Hulágú Il-Khán. <i>Type,</i> as described and figured in B. M. C., vol. VI, Nos. 21, 25, and Num. Or., No. CCLXXI. But at the bottom of the obv. area is the mint <i>Isfardín</i> اسفردين. Both margins are entirely cut away.</p>
155	1 ... 1					42,60	<p>* Abága Il-Khán, Obv. has inscription in Mongol characters, giving the name <i>Abúgáin</i>; rev. has the devise of the Seljúqí coins (lion with kalimah), as on No. 143. (<i>i</i>)</p>
156	1 . 1					41,41	<p>* Do. Size and type like B. M. C. of Or. Coins, vol. VI, No. 48; but the legend on the obv. square area is as on <i>ibid.</i> No. 51.</p> <p><i>Obv.</i> <i>Rev.</i> Square area : لا اله الا Mongol وحدة لا شريك له legend. محمد رسول الله</p> <p><i>Marginal sections :</i> ... منه احدى...</p>
157	1 1					62,74	<p>* † Do. Small size; lettered surfaces. Plate II, fig. 23. The legends as read by Mr. Rodgers are :</p> <p><i>Obv.</i> <i>Rev.</i> [ا] قا الله [ب] د شاه محمد عدل... رسول</p>

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
MONGOL IL-KHANS OF PERSIA.							
There are four minute crude letters in the space between الله and محمد which may possibly be <i>Abagha</i> in Mongol characters.							
158	2	...	...	...	2	63,55 66,84	* † ‡ Do. Small size; obv. legend surrounded by arabesques within circle; rev. legend within circle. Plate II, fig. 24. <i>Obv.</i>  <i>Rev.</i> [قان] العادل هراة
159	1	...	...	...	1	63,29	* † ‡ Do. Small size. Similar to No. 157, but obv. legend different. Plate II, fig. 25. <i>Obv.</i> قان العادل <i>Rev.</i> as on No. 157.
160	5	...	5	...	...	42,52 41,19 41,49 42,43 42,87	* † ‡ Do. <i>Type</i> , as in B. M. C., vol. VI, Pl. II, No. 41, but instead of stars there is an arabesque between the first and second lines of the legend in the square area. The segments contain arabesques, except one, which has the mint Marv (مرّو).
161	1	...	1	...	...	41,97	* Do. In all respects like No. 160, except that the mint is <i>Isfardîn</i> (اسفراين). (f)
162	1	...	1	...	...	42,61	* Do. Similar type to No. 160, but obv. inscriptions different; those in the marginal segments being in Mongol characters. Only the legend <i>Khaghanu</i> (the Great Khan's) in the top-segment is legi-

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
163	1 ...	1 ...	...	...	...	49,37	<p>MONGOL IL-KHANS OF PERSIA—<i>Contd.</i></p> <p>blo; the name which would probably have been in the bottom segment is entirely rubbed off. This is most unfortunate, as it has been impossible hitherto to determine the coins of this type with certainty. (i)</p> <p><i>Obv.</i> <i>Rev.</i></p> <p><i>Area:</i> لا اله الا الله فان وحده لا [شريك له] العادل محمد [د رسول الله] in ornamented Segment on top: <i>Khaghanu.</i> hexagram.</p> <p>† * † <i>Do.</i> <i>Type:</i> obv., circular area with inscribed margin; rev., scalloped circular area with inscribed margin. Both area legends as in No. 162; rev. marginal legend was in Mongol character, of which only traces of last word (<i>luk sen</i>) visible. Obv. margin entirely rubbed away. (i)</p> <p><i>Obv. area:</i> <i>Rev. area:</i> As in No. 162. القان <i>Margin:</i> illegible. العادل</p> <p><i>Margin:</i> <i>luk sen.</i></p>
164	1 ...	1 ...	...	...	...	42,56	<p>* <i>Do.</i> <i>Type:</i> circular areas with inscribed margins on both sides. Obv. margin entirely rubbed away; on the rev. margin there was the date. (i)</p> <p><i>Obv. area:</i> <i>Rev. area:</i> As in No. 162. القان [الا <i>Margin:</i> illegible. عظم العادل <i>Margin:</i> في سنة ثما...</p>
165	1 ...	1 ...	...	...	...	39,14	<p>* <i>Do.</i> <i>Type:</i> circular area with inscribed margins. Obv., creed in area, with date on margin; rev., a bow with 2 dots within it, under the titles. Plate II, fig. 26.</p>




Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
							MONGOL IL-KHANS OF PERSIA— <i>Contd.</i>
166	1 ...	1 ...	...			39,89	<p><i>Obv. area :</i> <i>Rev. area :</i></p> <p>الله قان</p> <p>لا اله الا العادل</p> <p>الله محمد </p> <p>رسول الله</p> <p><i>Margin.....</i> ضرب هذا الله</p> <p>* Do. <i>Type :</i> similar to No. 165; but date on rev. margin, and no dots in the bow.</p> <p><i>Obv. area :</i> <i>Rev. area :</i></p> <p>الله قان</p> <p>لا اله الا العادل</p> <p>محمد </p> <p>رسول <i>Margin : ستمايه.....</i> ضرب</p> <p><i>Margin : illegible.</i></p>
167	1 ...	1 ...	...			43,60	<p>* Do. <i>Type :</i> obv., square area within circle; rev., similar area with a bow below titles. Mint <i>Marv</i>, date 6**. Plate II, fig. 27.</p> <p><i>Obv. area :</i> <i>Rev. area :</i></p> <p>لا اله الا الملك الله</p> <p>الله محمد قان العادل</p> <p>رسول الله سكه مرو</p> <p><i>Segment at bottom : و ستمايه</i> </p> <p>others illegible.</p>
168	1 ...	1 ...	...			39,88	<p>Arghun. As described and figured in B. M. C., vol. VI, No. 60. Mint <i>Baghdad</i>, date 68*. Mr. Rodgers read the mint <i>Qazan</i>, which he supposes to be in Persia. There is no star either on the obv. or rev. (g)</p>
169	2 ...	2 ...	...			38,23 37,67	<p>* + ‡ Do. Similar to No. 168; but segments on obv. read as follows :</p> <p>top : مرو</p>

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
							MONGOL IL-KHANS OF PERSIA— <i>Contd.</i>
							left سنمايه (?) bottom : مرو right : و ثماين
170	1 ...	1 ...	...	...	...	34,98	giving the mint <i>Marw</i> apparently twice, and the date 68* incomplete. * Do. Similar to No. 168, but in obv. area, over الله, a quarter-foil instead of the star of B. M. C., vol., VI, No. 60. Segments illegible, except on the left side نى شهر (i)
171	1 ...	1 ...	...	...	...	38,10	* Do. Similar to Nos. 168 and 170, but in obv. area, over الله, a pyramid instead of a star. Segments, above..... ضرب right hand و ثماين ; other two illegible. Date * 8 * . (t)
172	1 ...	1 ...	...	...	...	38,39	* † ‡ Do. Similar to No. 168; but right hand segment contains a bow; the three others are illegible. (i)
173	2 ...	2 ...	...	...	...	38,83 36,84	* † ‡ Do. Similar to No. 169, but there is a bow within the rev. area, to the right of the Mongol legend. The segments read as in No. 169, but in different order: top : مرو left : و ثماين Mint : <i>Marw.</i> bottom : مرو Date : 68*. right : سنمايه...
174	2 ...	2 ...	...	...	...	40,70 38,55	The right hand segment shows traces of some more letters; and it may possibly have contained the unit figure. Plate II, fig. 28. * † ‡ Do. Same general type as in No. 168, but the Mongol legend on rev. is enclosed within a double circle, the outer dotted, the inner lined. The obv. area is

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
175	2 ... 2 ...					39,43 39,37	<p>MONGOL IL-KHANS OF PERSIA—<i>Contd.</i> marked by a quarter-foil as in No. 166. The segments read as follows:</p> <p>top: قازان <i>Rev.</i> left: عادل بازار اردو bottom: بازار اردو in minute letters right: شاه زاده (?) between 2nd and 3rd lines.</p> <p>Mr. Rodgers remarks on this coin: "This was struck apparently by Gházán or Qázán, the son of Arghun, at the Bazar of the Camp." Plate II, fig. 29.</p> <p>* † Do. Same general type as in No. 168, but the square area in obv. is formed by dots, instead of lines. The obv. area is marked by an arabesque. The obv. segments read as follows. Mint <i>Nisábu'r</i>, date *84.</p> <p><i>Obv.</i> top: نيسابور <i>Rev.</i> left: سنه اربع نيسابور bottom: نهالين in minute letters right: illegible between 2nd and 3rd lines.</p>
176	1 ... 1 ...					37,83	<p>* Do. Same general type as in No. 168, but the Mongol legend on rev. is enclosed in three circles, the exterior ones lined, the middle one dotted. The segments read as on No. 174, but in a different order. Mint <i>Bazár Urdú</i>. (i)</p> <p>top: بازار اردو <i>Rev.</i> left: قازان } illegible, except bottom } 1st line. right } illegible.</p>

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
180	1 ...	1 ...	...	...	...	37,40	MONGOL IL-KHANS OF PERSIA— <i>Contd.</i>
							<p><i>Obv.</i> <i>Area:</i> لا اله الا الله محمد رسول الله illegible scrawls</p> <p><i>Rev.</i> <i>Area:</i> قان الا عظم ارغون بادشاه عادل خلد</p> <p><i>Margin:</i> illegible. <i>Margin:</i> luksen.</p> <p>* Do. <i>Type,</i> obv., square area, the segments apparently only filled with dots; rev., small circular area formed by three circles, one dotted between two lined ones; with inscribed margin; mint <i>Astarabad</i>, date [68]5. Plate II, fig. 32. (f)</p>
							<p><i>Obv.</i> <i>Area:</i> لا اله الا الله محمد رسول الله على ولي الله</p> <p><i>Rev.</i> <i>Area:</i> قان ارغون</p> <p><i>Margin:</i> ... استراباد شهر سنة خمس.....</p> <p><i>Segments:</i> dots.</p> <p>Mr. Rodgers read the date ثمان, and observes: "I believe this is the first coin on which appears the formula 'على ولي الله'."</p>
181	1 ...	1 ...	...	...	...	42,66	<p>* Do. <i>Type:</i> same as in No. 156. Obv. legends same as in No. 152; segments, which probably contained the mint and date, illegible. Rev., Mongol legend with <i>Arghunu</i>. (t)</p>
182	1 ...	1 ...	...	...	...	20,26	<p>* Do. A beautiful coin with a complicated design. Obv., small double-lined square area, within an ornamental margin; the segments between square and marginal circle filled with arabesques. Rev., small double-scolloped circular area, within a margin filled with dots. Plate II, fig. 33. (f)</p>

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
							MONGOL IL-KHANS OF PERSIA—Contd.
							<div>Obv.</div> <div>Rev.</div> <div>Area : لا اله الا الله محمد رسول الله</div> <div>Area : Khagann Arbad Arghunū</div> <div>Margin : § § § § § § ∞</div> <div>Margin : ● ● ● ● ● ●</div>
183	1 ...	1 ...	...	...	...	42,67	* Do. Type : similar to No. 156, and to B. M. C., vol. VI, Pl. II, No. 48. The obv. legend as on the latter, and as on No. 182. Both sides are almost illegible; the left hand segment on the obv. is read by Mr. Rodgers <i>حنونسان</i> , mint ?" (i)
184	1 ...	1 ...	...	...	...	18,89	* Do. Type : same as in No. 168, with obv. marked by star, but the whole of margin, and partially sides of areas clipped away, to reduce size. Mint <i>Shirwān</i> (شیروان) or <i>Sabzwar</i> (سبزوار) in minute Persian letters between the 2nd and 3rd lines of rev. Mongol inscription. (g)
185	1 ...	1 ...	...	...	...	19,36	* Do. Type and legends, in all respects, as in No. 174, but exceedingly clipped to reduce size, as in No. 184. Of the obv. segments only remain, top <i>قاران</i> , and left [باز] ر اردو ; of the mint on rev. only <i>عاد</i> [ل] (g)
186	3 ...	3 ...	...	...	...	42,24 41,20 42,55	* Do. Type : similar to No. 177, obv., square area, within double circle, the inner dotted, the outer lined; segment partly inscribed, partly filled with arabesques. Rev., scalloped area, within ornamental border. Mint <i>Isfaráin</i> . (i)

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.																									
		Gold.	Silver.	Copper.	Mixed.																											
187	1 ...	1	42,93	<p>MONGOL IL-KHANS OF PERSIA—Contd.</p> <table><tr><td></td><td><i>Obv.</i></td><td><i>Rev.</i></td></tr><tr><td><i>Area :</i></td><td>لا اله الا الله</td><td>Khaghanu</td></tr><tr><td></td><td></td><td>Arbad</td></tr><tr><td></td><td>رسول الله</td><td>Arghunu</td></tr><tr><td></td><td>اسفراين</td><td>Deledkeksen</td></tr><tr><td><i>Segments :</i></td><td><i>top</i></td><td>Manghu</td></tr><tr><td></td><td><i>left</i></td><td rowspan="2">} cut away</td></tr><tr><td></td><td><i>bottom</i></td></tr><tr><td></td><td><i>right :</i></td><td>arabesque.</td></tr></table> <p>The fourth line of the Mongol legend seems to read as in B. M. C., vol. VI, Pl. II, No. 85. The word in the fifth line is now, either <i>manghu</i> or <i>maghnu</i>.</p> <p>* Do. Type: similar to No. 168, but obv. legend as in No. 186, and the whole exceedingly clipped, to reduce size. Mint <i>Nisábúr</i>. Obv. segments as follows:</p> <p>Top نيسابور; left and bottom cut away; right: في</p> <p>BUKHARA HOUSE OF TIMUR.</p> <p>188 1 ... 1 78,07 Sháh Rukh. As in B. M. C. of Or. Coins, vol. VII, Pl. II, No. 61. Date 828, but no mint. (f)</p> <p>189 1 ... 1 79,06 Do. Same type as No. 188, except that the corners of the obv. square form small ringlets. Mint <i>Sabzawár</i> (سبزوار) between 3rd and 4th lines of rev. legend. No date, unless worn away below last line. (f)</p> <p>190 1 ... 1 74,41 Do. Same type as No. 188, but a rosette inserted in rev. between رخ and بهادر. Mint <i>Salṭáníyah</i> (سلطانية), date * 47. The obv. is nearly effaced by being double struck</p>		<i>Obv.</i>	<i>Rev.</i>	<i>Area :</i>	لا اله الا الله	Khaghanu			Arbad		رسول الله	Arghunu		اسفراين	Deledkeksen	<i>Segments :</i>	<i>top</i>	Manghu		<i>left</i>	} cut away		<i>bottom</i>		<i>right :</i>	arabesque.
	<i>Obv.</i>	<i>Rev.</i>																														
<i>Area :</i>	لا اله الا الله	Khaghanu																														
		Arbad																														
	رسول الله	Arghunu																														
	اسفراين	Deledkeksen																														
<i>Segments :</i>	<i>top</i>	Manghu																														
	<i>left</i>	} cut away																														
	<i>bottom</i>																															
	<i>right :</i>	arabesque.																														

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.												
		Gold.	Silver.	Copper.	Mixed.														
191	1 ... 1					77.98	<p>BUKHARA' HOUSE OF TIMUR—Contd. with به بود. In B. M. C., vol. VII, No. 59, the date occupies the place of the rosette. (<i>t</i>) Do. Obv., square area divided into three compartments, with one line of creed in each; inscribed segments, entirely gone. Rev., circular area with illegible mint and date 848; inscribed margin, nearly gone. Rev. area is counterstruck with Abu Sa'id's name.</p> <table> <tr> <th>Obv.</th> <th>Rev.</th> <th>Counter.</th> </tr> <tr> <td>Area: لا اله الا الله محمد رسول الله</td> <td>Area: ضربت (?)</td> <td>کورگان</td> </tr> <tr> <td></td> <td>.....</td> <td>ابرسعيد</td> </tr> <tr> <td></td> <td>۸۴۸</td> <td>سلطان</td> </tr> </table> <p><i>Segments</i>: illegible. <i>Margin</i>: illegible. Mr. Rodgers reads the date 848. This is doubtful, however; it may be 868. Do. Doubtful. Counterstruck with 898 Khán (خان ۸۶۸); original legends illegible.</p>	Obv.	Rev.	Counter.	Area: لا اله الا الله محمد رسول الله	Area: ضربت (?)	کورگان		ابرسعيد		۸۴۸	سلطان
Obv.	Rev.	Counter.																	
Area: لا اله الا الله محمد رسول الله	Area: ضربت (?)	کورگان																	
	ابرسعيد																	
	۸۴۸	سلطان																	
192	1 ... 1					70.70	<p>Do. Doubtful. Counterstruck with 898 Khán (خان ۸۶۸); original legends illegible.</p>												
193	1 ... 1					76.66	<p>Husain Baikara, Governor of Khorásan (?). Compare B. M. C., vol. VII, No. 123, 126. Counterstruck in lozenge, on obv. به بود استراباد (<i>Asturábád</i>); on rev. in smaller lozenge به بود هرات (<i>Hirát</i>). Ascription of original coin unknown.</p>												
LINE OF SHAIBAN.																			
194	1					69.54	<p>Abdulláh II. Too illegible to be determined with certainty. Obv. area has the creed; the rev. area seems to read as in B. M. C., vol. VII, No. 150.</p>												

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
LINE OF SHAIBAN—Contd.							
							الله ن عبد بہادر خا
195	1	...		1	...	40,47	Mr. Rodgers ascribes it to Iskandar Sháh (as <i>ibid.</i> No. 145). Undetermined. On obv., in scalloped area, ضرب بلخ mint <i>Balkh</i> . (i) •
196	1	...		1	...	48,58	Undetermined. Two circular areas. (i) Obv. Rev. ضرب ... لا عظم مرو (P) ... والدین
MANG'IT DYNASTY.							
197	1	1	...	...	...	70,50	† Muzaffaru-d-dín. A modern tilla; similar in type to B. M. C., vol. VII, Pl. V, No. 179. Mint <i>Bukhárá</i> , date 1297. Legends as <i>ibid.</i> , No. 179. (g)
198	1	...	1	...	...	48,25	Do. Haidari type, as in B. M. C., vol. VII, Pl. V, No. 212. Mint <i>Bukhárá</i> , date 1278. (t)
199	1	...	1	...	...	48,20	Do. A variety of No. 198; but with date 1283 on reverse. Mint <i>Bukhárá</i> . (t) Obv. Rev. شريف عا محمود مرب بچارا قبت حيدر مرحوم امير
200	1	...		1	...	83,66	Undetermined. Broad thin piece, about 1½ inches in diameter; bilingual, Persian and Chinese. Obv., small circular area with سكه بچارا (money of <i>Bukhárá</i>); broad

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
							MANGIT DYNASTY— <i>Contd.</i>
							ornamental margin, apparently with traces of Persian inscription. Rev., small octagonal area with Chinese legend; broad ornamental margin, apparently with Arabic inscription.
							ŞAFAWI DYNASTY OF PERSIA.
201	1 ...	1 ...	...	...	...	40,01	Ismá'íl I. As described and figured by Mr. Oliver in J. A. S. B., vol. LVI, Pl. I, No. IV. Mint <i>Nimroz</i> , date 929. About one-third is broken off.
202	1 ...	1 ...	...	...	...	79,48	† Husain bin Sulaimán. As in J. A. S. B., vol. LVII, Pl. II, No. XXIV. Mint <i>Isfahán</i> , date 1130. With a brass loop for suspension. (g)
203	1 ...	1 ...	...	...	...	76,96	Do. The same, but mint <i>Tabríz</i> , date 1131. (g) With a brass loop for suspension.
204	1 ...	1 ...	...	...	...	74,15	Do. A variety of No. 202; the obv. only, but not the rev., has a marginal circle of pellets. Mint <i>Isfahán</i> , date 1120. With a brass loop for suspension. (g)
205	1 ...	1 ...	...	...	...	82,16	† Do. Another variety of No. 202; as in J. A. S. B., vol. LVI, Pl. II, No. XXI. The obv. margin is inscribed, the rev. margin is studded with pellets; the areas are formed by dotted circles. Mint <i>Qazwin</i> , date 1131. With a brass loop for suspension; also pierced near margin. (g)
206	1 ...	1 ...	...	...	...	80,40	Do. Another variety of No. 202; as in J. A. S. B. vol. LVI, Pl. II, No. XXII. The obv. margin inscribed, the reverse ornamented with floral design. Mint <i>Tiflis</i> , date 1132. With brass loop for suspension. (g)
207	1 ...	1 ...	...	...	...	76,90	* Mahmúd. Type the same as No. 204; obv., circular area with margin studded with pellets; rev., lettered surface without margin. No mint or date. With a brass loop for suspension. Plate II, fig. 34.

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
ŞAFAWĪ DYNASTY OF PERSIA—Contd.							
							<div><div>Obv.</div><div>لا اله الا الله محمد رسول الله على و لى الله</div></div> <div><div>Rev.</div><div>مسكه صاحبقران ...توفيق اله امير ميه... گاه محمود سها... (only partially legible.)</div></div>
208	1 ...	1 ...				75,29	Ashraf. Type the same as No. 204; like No. 200, p. 67, in B. M. C., of Shāhs of Persia. Mint <i>Isfahān</i> , date 1137. With brass loop for suspension. (g)
209	1 ...	1 ...				85,05	† Tahmāsp II. Type similar to No. 202, but the areas are formed by dotted circles, as in Num. Or., No. DLXXI, Mint <i>Isfahān</i> , date 1147. With a brass loop for suspension. (g)
210	1 ...	1 ...				76,37	Do. A variety of No. 209, obv. margin inscribed, as in J. A. S. B., vol. LVI. Pl. III, No. XXIX. See also No. 150, p. 56 of B. M. C., of Shāhs of Persia. Mint <i>Tabrīz</i> , date 1134. With a brass loop and perforation for suspension. (g)
211	1 ...	1 ...				82,44	Do. The same as No. 210, but mint <i>Mashhad Muqaddas</i> , date 1137. The margins are entirely cut away, with the exception of one trace at the side with <i>ولي</i> on the obv. With a brass loop for suspension. (i)
212	2 ...	2 ...				78,48 77,94	Nādir. As described and figured by Mr. Oliver, in J. A. S. B., vol. LVI, Pl. III, No. XXXV, and B. M. C. of Shāhs of Persia, No. 1, p. 72. Mint <i>Mashhad</i> , date 1150. In one specimen the date is nearly rubbed out. With brass loop for suspension. (f)
213	1 ...	1 ...				61,24	Do. As figured in Num. Or., No. DLXXXV, and described on p. 472. The margins are nearly rubbed away, hence mint and date almost illegible, but probably <i>Mashhad</i> 1150. See also J. A. S. B., vol.

Serial Number.	Number of Coins.	METAL.				Weight in grainf.	Description.
		Gold.	Silver.	Copper.	Mixed.		
SAFAWI DYNASTY OF PERSIA—Contd.							
214	1 ...	1 ...	...	...	74,51	LVI, Pl. IV, No. XXXVII. With brass loop for suspension. Karím Khán (P). Mr. Rodgers observes: "no name on the coin, obv., the distich as on Karím Khán's coins in B. M. C. of Sháhs of Persia, Introduction, p. lxxxvii. Rev. ضرب دارالمومنین كاشان. Mint Káshán; no date. With brass loop for suspension. (t)
215	1 ...	1 ...	...	...	40,51	Undetermined. Obv., quarter-foil area with Shi'ah creed, and inscribed margin, nearly illegible. Rev., two scalloped areas, one within the other, and dotted margin. Legend in inner area illegible; outer ..........فی شهر
216	1 ...	1 ...	...	...	22,34	Undetermined. Mint Isfahán. Mr. Rodgers reads as follows: "Obv. ضرب اصفهان Rev. in lozenge مبارک. سكو شاه (P) Margin lost."
217	1 ...	...	...	...	13,56	Medal or Token of brass. Obv., the Persian rayed and faced sun in middle of wreath of oak-leaves and acorns. Rev., crescent and stars in middle of ditto.
AFGHANISTÁN.							
218	1 ...	1 ...	...	...	163,61	Mahmúd Durrání. A rupee as figured in Num. Chron., III ^d Series for 1888, Pl. XIII, fig. 12, p. 352. Mint Hirát, date 1230. Legends on both sides almost entirely worn off. Obv. Rev.

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
219	1 ...	1 ...	...	...	41,44	<p>AFGHANISTAN—Contd.</p> <p>Do. A quater Rupee. Mint gone; date 1241. Most of the legend gone.</p> <p><i>Obv.</i> ستان محمود</p> <p><i>Rev.</i> ۱۶۴۱ السلطنة... ضرب</p>
220	1 ...	1 ...	...	...	141,65	<p>'Abdu-r-Rahmán. A rupee. Mint Kábul, date 1298. Very imperfectly struck, showing portion only of legends; edges much hacked about.</p> <p><i>Obv.</i> میر حسن عبد الرحمن</p> <p><i>Rev.</i> ضرب دار السلطنة [کابل]</p>
221	1 ...	1 ...	...	...	143,10	<p>Do. A rupee. Another Variety. Mint and date cut away. In the same condition as No. 220.</p> <p><i>Obv.</i> امیر الرحمن [عبد]</p> <p><i>Rev.</i> ضرب دار.....</p>
222	5 ...	5 ...	...	...	142,17 141,52 141,21 138,41 137,75	<p>Undetermined. All Rupees. Mint Kábul; dates, only visible on three, ***97, *** 4, **** 4. In the same general condition, as Nos. 220 and 221.</p> <p><i>Obv.</i> ن حب یا الزما ما</p> <p><i>Rev.</i> ضرب دار کابل السلطنة [12]97</p> <p>i. e. یاصاحب الزمان</p>

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
AFGHANISTAN—Contd.							
223	1 ...	1 ...	...	...	...	143,18	Undetermined. A rupee, with an incomplete and unread Persian distich on the obv.; and with mint Dáru-s-Saltanat Kábul and date 1250 on rev.
224	1 ...	...	...	1 ...	...	46,72	Undetermined. Obv., square area with arabesque in segments; rev., round area with ornamental margin. No mint, date ** 75. <div style="display: flex; justify-content: space-around;"><div><i>Obv.</i> <i>Area :</i> سنه خمس سبعين .....</div><div><i>Rev.</i> ضرب هراة</div></div>
225	1 ...	...	...	1 ...	...	43,60	Undetermined. Obv, lozenge area within ornamental margin; rev., floral geometric figure. <div style="text-align: center;"><i>Obv.</i> ضرب هراة بلدة</div>
226	1 ...	...	...	1 ...	...	38,57	Undetermined. A variety of No. 224. Mint Hirát on obv., and date 887 or 878 on rev. <div style="display: flex; justify-content: space-around;"><div><i>Rev.</i> هر اله</div><div><i>Obv.</i> ٨ ٨ سنه ٧</div></div>
227	1 ...	...	...	1 ...	...	47,16	Undetermined. A variety of No. 224, but obv. scalloped area, rev. square area. Mint Hirát, no date. <div style="display: flex; justify-content: space-around;"><div><i>Obv.</i> ربيع التاريخ</div><div><i>Rev.</i> ضرب هراة</div></div>
228	1 ...	...	...	1 ...	...	36,68	Undetermined. Mint Hirát; date ** 55. Obv., lotus shaped design; the centre has i. e., فى التاريخ

Serial Number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
AFGHANISTAN—Contd.							
							هراء; on two of the pedals عدل; the rest illegible. Rev., in round area : فی خمیس سنه و خمیسین
229	1	1 ...				77,26	Undetermined. Another variety of No. 225, but of much larger size. Mint Hirát, date 919. <i>Obv.</i> ۹۱۹ سنه ب هراء [ضرب]
230	1	1 ...				46,82	Undetermined. Another variety of No. 225; mint Hirát (?), date gone. <i>Obv.</i> ضرب دارالسلطنه هراء (?)
231	1	1 ...				34,24	Undetermined. Another variety of No. 225. <i>Obv.</i> ...ضرب; <i>Rev.</i> illegible.
RAJPUTS OF INDIA.							
232	1	1				52,02	Prithví Rája. As in <i>Ar. Ant.</i> , Pl. XIX, fig. 18; <i>Ind. Ant.</i> , vol. I, pl. XXV, fig. 21, pl. XXVI, fig. 30; also <i>Chron.</i> , p. 64, No. 38. (<i>t</i>)
233	4	4				53,23 51,97	Cháhada Deva. With legend <i>Saman-tadeva</i> ; as in <i>Ar. Ant.</i> , Pl. XIX, fig. 16; also <i>Chron.</i> , No. 39, p. 70. (<i>t</i>)
234	2	2				51,45 50,74	Do. With legend <i>Samasarola</i> ; as in <i>Chron.</i> , No. 40, p. 70, pl. I, fig. 15, also <i>Ar. Ant.</i> , Pl. XIX, fig. 31, 34, 37; <i>Ind. Ant.</i> , Pl. XXVI, fig. 31. (<i>t</i>)

Serial number.	Nnmber of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
RAJPUTS OF INDIA.—(contd)							
235	3	.....			3	50,16 49,07 47,10	Madana Pála. As in Ar. Ant., Pl. XIX, fig. 19, 23, Ind. Ant., Pl. XXV, fig. 16, Pl. XXVI, fig. 27, J. R. A. S., vol. IX, fig. 13; also Chron., p. 62, No. 34. (t)
236	1	.....			1	50,03	Sallakshana Deva. As in J. R. A. S., vol. IX, fig. 11, 12; also Chron., p. 62, No. 33. (t)
MUGHALS OF INDIA.							
237	1	...	1	...		175,25	Farrokh Siyar. A rupee. As in Num. Or., No. DCCCCXII, but mint Dárn-l-Saltanat Láhor, date 1126, regnal 2. (f)
SOUTH INDIAN.							
238	1	.....		1	...	47,62	Qutbu-d-dín Fírúz. Doubtful, but see Madras Journal of Literature and Science, for 1888-89, fig. 4, p. 56. Lettered surfaces enclosed within double circle, the inner lined, the outer dotted. (i)
<div style="display: flex; justify-content: space-between;"><div><i>Obv.</i> قطب الدنيا والدين } م</div><div><i>Rev.</i> شاه (P) فيروز</div></div>							
UNDETERMINED.							
239	1	.....		1	...	104,80	Unknown. Circular areas with inscribed margins. Each area contains the exceedingly crude figure of an animal, which cannot be identified. The marginal legends are almost entirely worn off and quite illegible. (i)
240	36	.....		36	...	39,09 23,29 13,66 12,09 11,59 7,70 7,52	Unknown. Mere copper-drops of varying sizes and weights. Mr. Rodgers observes: "No king's name on them. Some are very small, weighing only 4 grains of copper. They were all made of <i>drops</i> of copper which were stamped on both sides by dies bearing Kufic inscriptions. The edges are still con-

Serial number.	Number of Coins.	METAL.				Weight in grains.	Description.
		Gold.	Silver.	Copper.	Mixed.		
							<p style="text-align: center;">UNDETERMINED.—<i>Contd.</i></p> <p>vex. Some weigh over 50 grains. They all agree in not being prepared for the die by cutting or hammering. No definite description has yet been deciphered. Some of them have عدل ('<i>adl</i>) on one side; some have a geometric device. There is not sufficient inscription on any coin to enable me to assign them to any king." The weights on the margin are those of seven of the best selected specimens.</p>

N. B. Of the following Numbers there are a number of spare specimens, all being much inferior to those selected for the Indian Museum and noticed in the Catalogue.

Nos. 51—54, 224 specimens.

Nos. 60—70, 48 do.

No. 75, 11 do.

Nos. 76—83, 107 do.

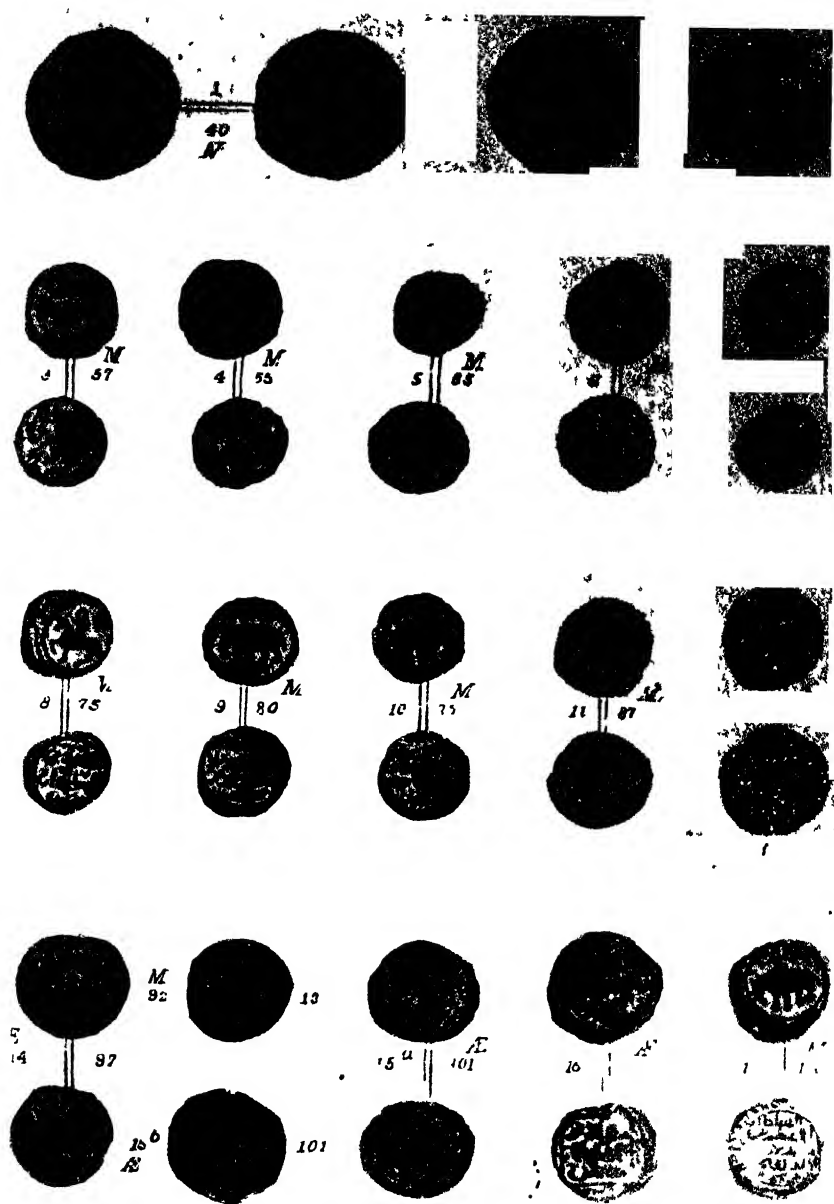
Nos. 84—86, 47 do.

No. 146, 148 do.

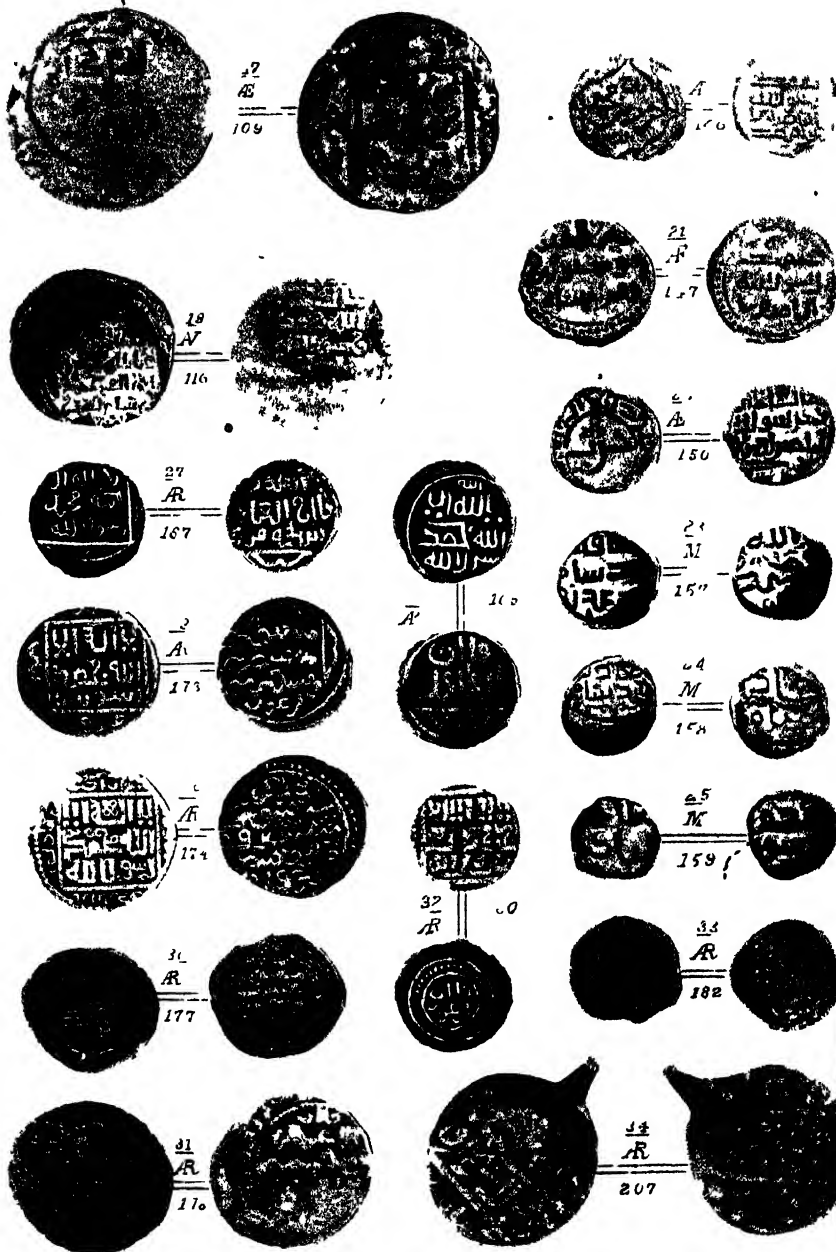
No. 240, 210 do.

POSTSCRIPT.

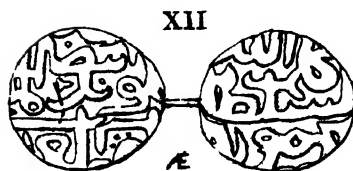
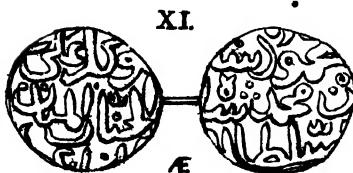
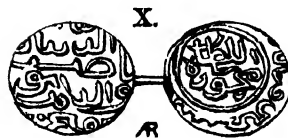
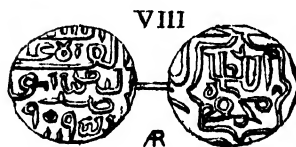
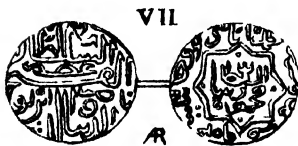
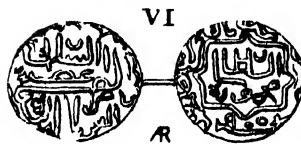
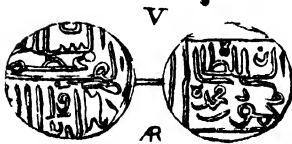
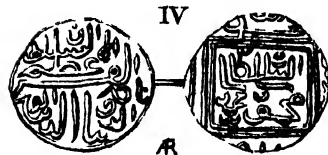
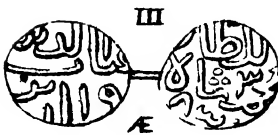
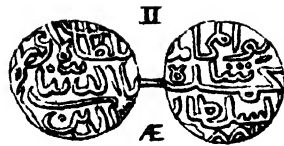
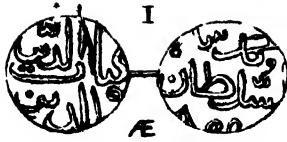
The foregoing pages had already passed through the press, when I received from Professor W. Tiesenhausen of Petersburg a copy of his paper on the Oriental Coins of Mr. Linévitch, published in the Transactions of the Oriental Section of the Russian Archæological Society, Vol. IV, pp. 289—320. Among the coins described in this paper, I find several which appear to be identical with some in the Museum Collection. Thus Prof. Tiesenhausen's No. 6 shown in his Pl. I, figs. 2, 3 is the same as Ind. Mus. Cat. No. 77. The mint is read by the Professor as جزوان. His No. 7 seems to be the same as Ind. Mus. Cat. No. 51, but in the woodcut, accompanying No. 7, the horse is shown without a saddle. His No. 8 (with a woodcut) is the same or nearly the same as Ind. Mus. Cat. No. 101. Others are: No. 1 = Ind. Mus. Cat. No. 149; No. 3 = Ind. Mus. Cat. No. 95 or No. 105. Prof. Tiesenhausen's No. 29, which is dated 798 A. H. in Tímúr's reign, very much resembles Ind. Mus. Cat. No. 230; and the latter, therefore, is probably to be attributed to Tímúr. So are, in all probability, Ind. Mus. Cat. Nos. 224, 225, 226, which in design have much resemblance with No. 230. In fact, the date of No. 226 is probably to be read 788 in Tímúr's reign. No. 229 of the Ind. Mus. Cat., to judge from its date 919 A. H., may be a coin of Ismá'il I, the first king of the Şafawí dynasty of Persia (905-932 A. H.).



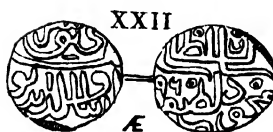
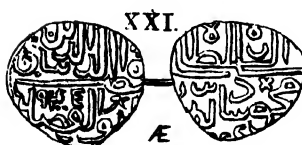
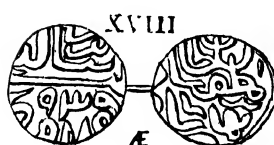
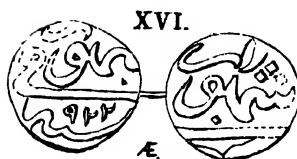
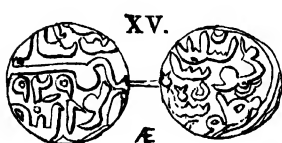
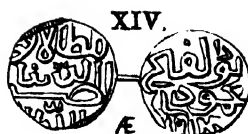
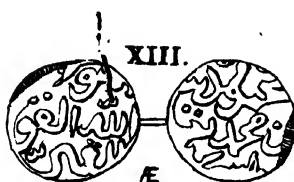
Central Asiatic Coins in the Indian Museum



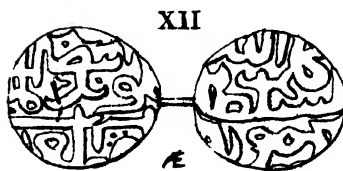
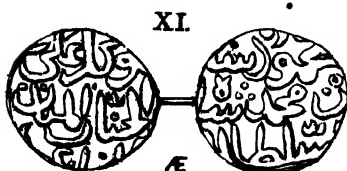
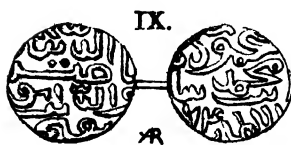
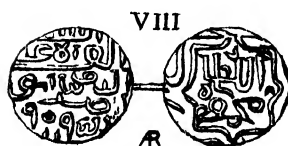
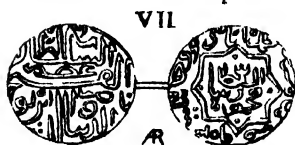
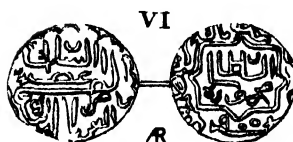
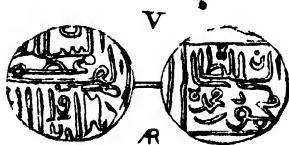
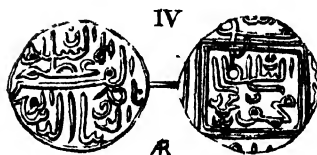
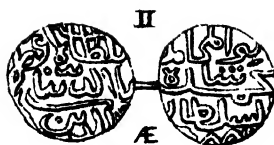
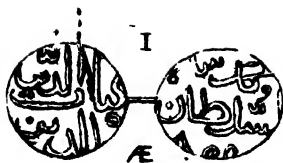
Central Asiatic Coins in the Indian Museum.



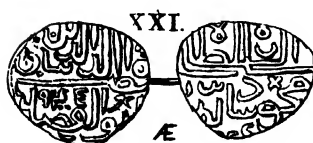
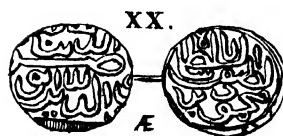
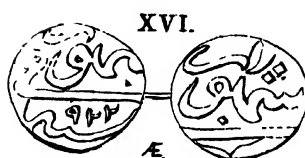
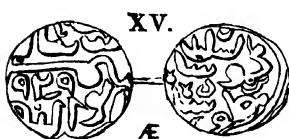
COINS OF THE MUHAMMADAN KINGS OF GUZARÁT.



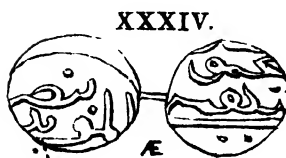
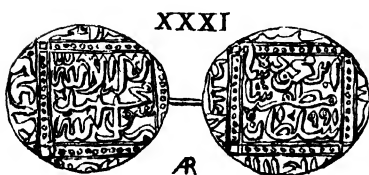
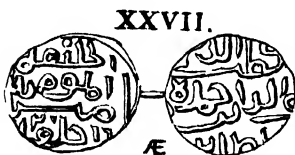
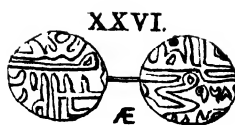
COINS OF THE MUHAMMADAN KINGS OF GUJARAT.

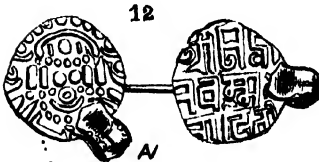
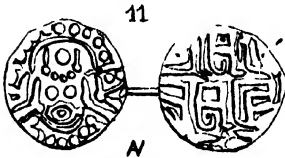
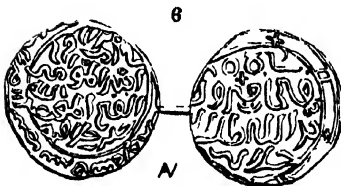
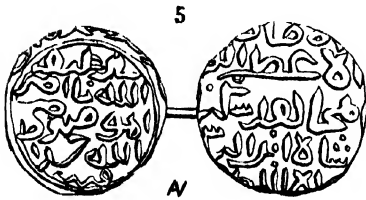
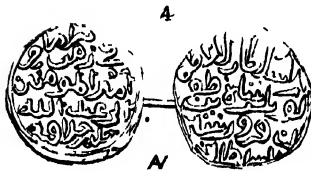
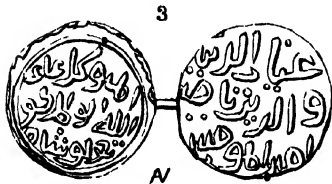
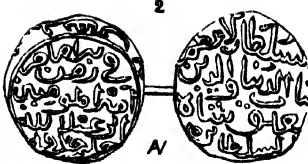
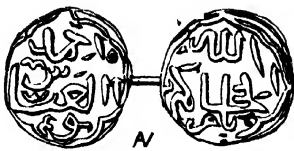


COINS OF THE MUHAMMADAN KINGS OF GUZARÁT.



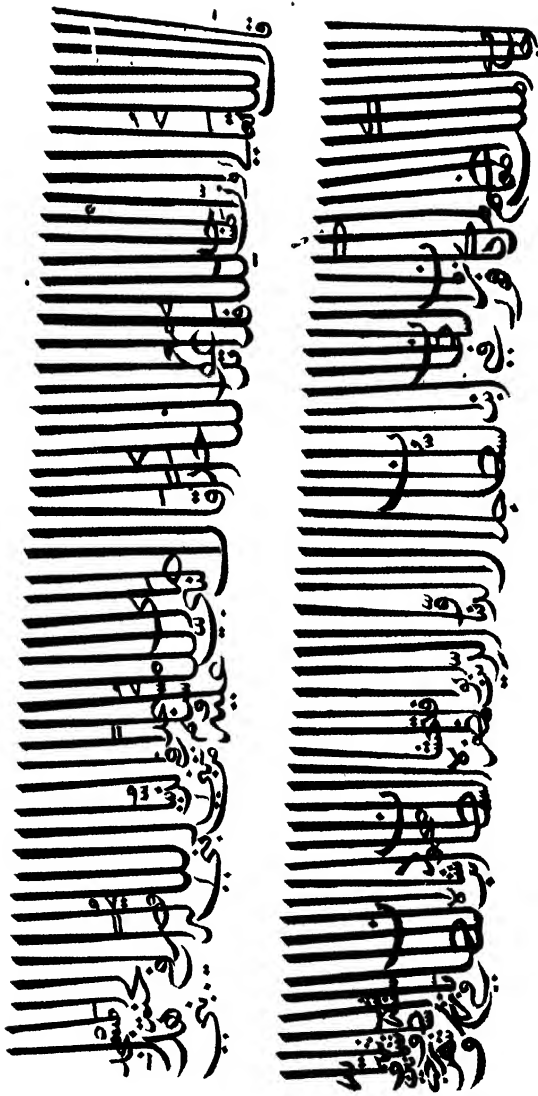
COINS OF THE MUHAMMADAN KINGS OF GUJARÁT.





SOME NEW OR RARE HINDU AND MUHAMMADAN COINS.

LITHOGRAPHED BY A. L. PAIN, CALCUTTA, 1889.



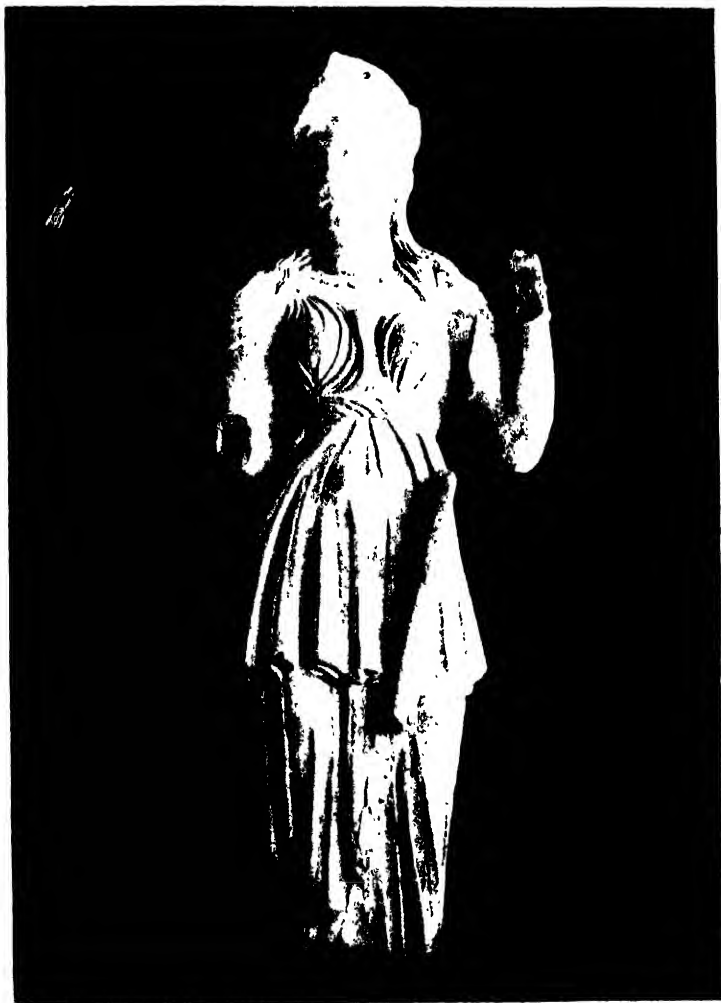
INSCRIPTION OF JALÁLU-D-DÍN FATH SHÁH. DATED 888 A. H.
IN THE MOSQUE OF ÁDAM SHAHÍD, NEAR RÁMPÁL.

— LITHOGRAPHED BY A. T. BAKER —



COPPER-SILVER SEAL OF KUMĀRA GUPTA.

FIG. 1.



Pharmacology

13. *See* 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 267

PALLAS ATHÉNÉ LAURE MUSÉE



1

2

3



1. BIRTH OF BUDDHA



2. GUPTA MACHA



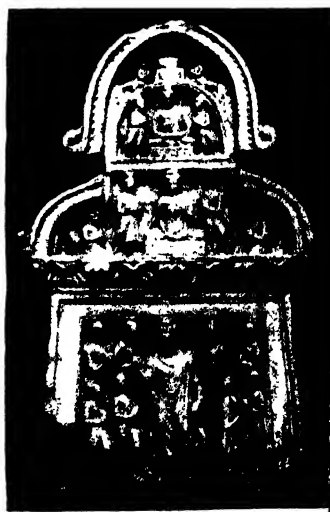
3. GUPTA MACHA



4. INDIAN HEAD



5. SEATED BUDDHA



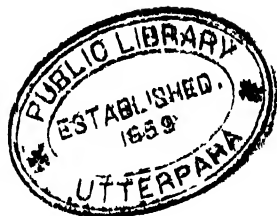
6. CHAITYA PANEL



PLATE X
A. S. B. VOL. LVIII. PT. I. 1889.

JOURNAL
OF THE
ASIATIC SOCIETY OF BENGAL.

VOL. LVIII.



PART II., (NATURAL HISTORY, &c.)

(Nos. I to V—1889, with two Supplements)

EDITED BY

J. WOOD-MASON, ESQ.,

VICÉ PRÉSIDENT.

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“It will flourish, if naturalists, chemists, antiquaries, philologists, and men of science in different parts of *Asia*, will commit their observations to writing, and send them to the Asiatic Society at Calcutta. It will languish, if such communications shall be long intermitted and it will die away, if they shall entirely cease.” SIR WM. JONES.

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CALCUTTA:

PRINTED AT THE BATHURST MISSION PRESS,

AND PUBLISHED BY THE

ASIATIC SOCIETY, 57, PARK STREET.

1890.

LIST OF CONTRIBUTORS.

	Page
ALCOCK, ALFRED;— <i>Natural History Notes from H. M.'s Indian Marine Survey Steamer 'Investigator,' Commander ALFRED CARPENTER, R. N., D. S. O., commanding. No. 10. List of the Pleuronectidæ obtained in the Bay of Bengal, in 1888 and 1889, with descriptions of new and rare species (Plates XVI—XVIII),</i>	279
—————;— <i>Natural History Notes from H. M.'s Indian Marine Survey Steamer 'Investigator,' Commander ALFRED CARPENTER, R. N., D. S. O., commanding No. 12. Descriptions of some new and rare species of Fishes from the Bay of Bengal obtained during the season of 1888-89. (Plate XXII.),</i>	296
ANDERSON, HENRY H.;— <i>Notes on Indian Rotifers. (Plates XIX—XXI.)</i>	345
ATKINSON, E. T.;— <i>A new Species and Genus of Coccidæ. (Plate I),</i>	1
—————;— <i>Notes on Indian Rhynchota; Heteroptera, No. 5,</i>	20
—————;— <i>Index to the first five Papers on Indian Rhynchota, completing the Family Pentatomidæ:—I Journ. lvi. pt. ii, p. 22, 1887; II, ib., p. 144: III, ib. lvii, p. 1, 1888: IV, ib, p. 118: V, ib., lviii, p. 20, 1889,</i>	441
BARCLAY, A.;— <i>A Descriptive List of the Uredinæ, occurring in the neighbourhood of Simla (Western Himalayas). Part II. Puccinia. (Plates XII.—XIV.)</i>	232
BOURNE, ALFRED GIBBS;— <i>On certain Earthworms from the Western Himalayas and Dehra Dun. (Plate III.)</i>	110
DOHERTY WILLIAM;— <i>Notes on Assam Butterflies. (Plate X.)</i>	118
—————;— <i>On certain Lycænidæ from Lower Tenasserim. (Plate XXIII),</i>	417
HILL, S. A.;— <i>The Tornadoes and Hailstorms of April and May 1888 in the Doab and Rohilkhand. (Plates IV.—IX),</i>	135
KING, GEORGE;— <i>Materials for a Flora of the Malayan Peninsula.</i>	359
LETHIERRY, M. L.;— <i>Definitions of three new Homoptera,</i>	252
LYDEKKER, R.;— <i>On the Tortoises described as Chaibassia. (With two Wood-cuts),</i>	327

	Page
MUKHOPADHYAY, ASUTOSH ;— <i>The Geometric Interpretation of Monge's Differential Equation to all Conics</i> ,.....	181
————— ;— <i>Some applications of Elliptic Functions to Problems of Mean Values. (First Paper). (With a Wood-cut)</i>	199
————— ;— <i>Some applications of Elliptic Functions to Problems of Mean Values. (Second Paper)</i>	213
OATES, EUGENE W. ;— <i>On the Species of Thelyphonus inhabiting Continental India, Burma, and the Malay Peninsula. (Plate II.)</i>	4
PEDLER, ALEX. ;— <i>On the Volatility of some of the compounds of Mercury and of the metal itself.</i>	189
PRAIN, D. ;— <i>Noviciæ Indicæ I. Some additional species of Pedicularis,</i>	255
SCLATER, W. L. ;— <i>Description of a Stag's Head allied to Cervus dybowskii, Tac., procured from the Darjeeling Bazaar. (Plate XI.)</i>	185
SIMON, E. ;— <i>Étude sur les Arachnides de l' Himalaya recueillis par M M. OLDHAM et WOOD-MASON et faisant partie des collections de l' Indian Museum, I^{re} Partie</i> ,.....	334
WOOD-MASON, J. ;— <i>Notice of a Neolithic Celt from Jushpur in the Chota Nagpur District. (Plate XV.)</i>	254
————— ;— <i>The Ethiopian and Oriental Representatives of the Mantodean Subfamily Vatricæ,</i>	306

Supplement No. 1.

ATKINSON, E. T. ;— <i>Catalogue of the Insecta of the Oriental Region No. 1. Order Coleoptera, Family Cicindelidæ,</i>	1
————— ;— <i>Catalogue of the Insecta. Order Rhynchota. Sub-order Hemiptera-Heteroptera. Family Capsidæ,</i>	25

Supplement No. 2.

WATERHOUSE, J., COLE, W. H. and POPE, T. A. ;— <i>Metric Weights and Measures prepared for the use of the Photographic and Lithographic offices, Survey of India,</i>	1
--	---

Dates of issue of the different numbers of the Journal, Pt. II, 1889.

- No. 1.—Containing pp. 1—134, with Plates I, II, & III, was issued on May 21st, 1889.
- No. 2.—Containing pp. 135—254, with Plates IV, V, VI, VII, VIII, IX, X, XI, XII, XIII & XIV, was issued on September 3rd, 1889.
- No. 3.—Containing pp. 255—326, with Plate XV, was issued on November 7th, 1889.
- No. 4.—Containing pp. 327—440, with Plates XVI, XVII, XVIII, XIX, XX & XXI, was issued on December 30th, 1889.
- No. 5.—Containing pp. 441—448, with Plates XXII & XXIII, and Title-page, Index, &c., to the Volume, was issued on September 3rd, 1890.
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*Dates of issue of the different numbers of the Journal, Pt. II, Supplement,
1889.*

- No. 1.—Containing pp. 1—199, was issued on January 17th, 1890.
- No. 2.—Containing pp. 1—15, was issued on October 24th, 1889.

LIST OF PLATES.

- I.—*Pseudopulvinaria sikkimensis*, n. sp.
II.—*Indian species of Thelyphonus*.
III.—*Typhæus Masoni*, sp. nov. and *Perichæta houlletii*.
IV—IX.—*Maps illustrating barometric pressure in the Douab and Rohilkhand*.
X.—*Assam Butterflies*.
XI.—*Head of Cervus dybowskii*.
XII. }
XIII. } *Species of Puccinia found in the neighbourhood of Simla*.
XIV. }
XV.—*Neolithic Celt from Jashpur*.
XVI. }
XVII. } *Pleuronectidæ from the Bay of Bengal*.
XVIII. }
XIX. }
XX. } *Indian Rotifers*.
XXI. }
XXII.—*New and Rare Fishes from the Bay of Bengal*.
XXIII.—*Lycanidæ from Tenasserim*.
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JOURNAL

OF THE

ASIATIC SOCIETY OF BENGAL.



Part II.—NATURAL SCIENCE.

No. I.—1889.

I.—*A new Species and Genus of Coccidæ.*—By E. T. ATKINSON, B. A.

[Received September 30th;—Read November 7th, 1888.]

(With Plate I.)

The Coccid described below was received from Mr. F. Gammie, who procured it at Munghphu (3800 feet) in Sikkim on *Quercus incana*, *Castanea indica*, and *C. tribuloides*. I forwarded specimens to Mr. T. Maskell of Wellington, New Zealand, who devotes much attention to this family, and he has kindly sent me the drawings of the insect in its different stages shown on the accompanying plate. This coccid clearly belongs to Maskell's group *Hemicoccina*, which is characterised by having, in the larval stage, the anal tubercles of the *Coccina*, and, in the adult female, the abdominal cleft and lobes of the *Lecanina*. I had provisionally placed this insect in the genus *Pulvinaria* of the group *Lecanina*, as the adult female does not appear to differ from the adult females of that genus. Mr. Maskell was at first of the same opinion, but, having examined the larval form in its earliest stages, he found that it presented undoubted and distinct 'anal tubercles' (Fig. 11), which at once remove it from the *Lecanina*.

It cannot be placed in the genus *Kermes* of the group *Hemicoccina* owing to structural differences, so that we have to form a new genus, to which the name *Pseudopulvinaria*, as suggested by Mr. Maskell, has

been given to show its connection with the lecanid genus *Pulvinaria*. The insect is really a hemiococcid possessing more lecanid appearances than any other of the group hitherto known. The position of the insect on the tree during its several stages is rather curious. The larvæ and the females of the second stage cluster along the midrib of the lower surface of the leaf, whilst the adult female alone is found along the twig to which the leaves are attached (Fig. 1). The secretion is closer than in *Pulvinaria*, and quite as cottony during the larval stage, but, in the second stage, becomes more waxy, so as to approach in appearance the genus *Orthezia*, and the masses of wax on the leaves are more like detached or attached plates (Fig. 2) than threads. Unfortunately the male has not yet been secured.

It is satisfactory to know that the adult female is subject to the attacks of several species of hymenopterous and dipterous parasites, which we may hope to characterise hereafter, for, otherwise, from the size and number of these coccids on the leaves and twigs affected, much damage must ensue, should they increase to any extent. It disappears during the rains (July—September), but comes on abundantly at the close of the rains, and matures about April.

Genus PSEUDOPULVINARIA nov.

Adult females naked, without a waxy fringe, somewhat circular or oval and flattish. In *Kermes*, the adult female is entirely globular, except a small incision where it rests on the twig to which it is attached, and appears to have neither legs, antennæ, nor rostrum.

PSEUDOPULVINARIA SIKKIMENSIS, n. sp.

Adult ♀, above reddish-brown, naked, somewhat convex, irregularly circular or oval in shape, varying in size, skin smooth, punctulate. The insect frequently falls off, leaving the white cottony ovisac attached to the twig. Furnished beneath with eyes, antennæ, legs and rostrum; the abdominal cleft and lobes distinct (Fig. 5): antennæ borne on a tubercle, 6-jointed, second joint longest, unarmed; others with setæ varying in length (Fig. 6): claw with four digitules, the upper pair longest (Fig. 7). The ovisac on which the female rests is formed of a compact white cerous substance, following and extending beyond the outline of the insect itself. The spinnerets (*filières*: Fig. 8) are scattered irregularly over the nether caudal surface and are not arranged in groups or circles. Found only on the twigs: long, 5—9 mill.

The ♀ of the second stage (Fig. 9) with its waxy plates is found on the lower surface of the midrib of the leaf. These plates seem to be

attached transversely to a longitudinal median ridge and give this form a peculiar ribbed appearance.

The larval form is furnished with antennæ, legs, rostrum, and anal tubercles bearing long setæ (Fig. 10). These tubercles are very distinct in the earliest stage of the larva (*l'état embryonnaire*: Fig. 11), and are characteristic of the group.

The ♂ is unknown.

Hab. Mungphu (3800 feet), Sikkim.

EXPLANATION OF PLATE I.

- Fig. 1. Insect on twig and leaves: slightly reduced.
 2. Waxy masses on leaves, magnified.
 3. Adult ♀, dorsal aspect, cotton removed: magnified about 4.
 4. Same, ventral aspect, cotton removed: magnified.
 5. Same, abdominal cleft, lobes, anogenital ring and spinnerets: do.
 6. Same, antennæ: × 90.
 7. Same, claw and digitules: × 90.
 8. Same, spinnerets: magnified.
 9. ♀ of second stage, dorsal aspect, with waxy plates.
 10. Larva, ventral aspect: × 90.
 11. Anal tubercles just before emerging from the egg: magnified.
 12. Edge of the body of larva with hairs &c.: × 350.
-

II.—*On the Species of Thelyphonus inhabiting Continental India, Burma, and the Malay Peninsula.*—By EUGENE W. OATES, F. Z. S. Communicated by THE SUPERINTENDENT OF THE INDIAN MUSEUM.

[Received January 24th ;—Read April 3rd, 1889.]

(With Plate II.)

The obscure animals which belong to this genus are very little known. I have steadily collected them for some years now with the best results, and not long since I took the opportunity of studying the specimens contained in the Indian Museum, all of which were very kindly placed at my disposal by Mr. J. Wood-Mason, the Superintendent of the museum.

There are now thirteen species known within the above limits, of which three have been already described, eight are new to science, and two are unknown to me, and in my opinion insufficiently described to be ever determinable. These two were described by Mr. A. G. Butler many years ago and in terms which, when applied to these animals, are altogether insufficient. For this reason I have excluded them from this paper, and I hope to notice them on a future occasion, when I have had time to examine the types, which I understand are in the British Museum. These two species are *T. sepiaris*, described from Tonghoo and Ceylon, and *T. nigrescens*, from Tenasserim (Cist. Ent. vi, p. 129).

The *Thelyphoni* live under timber and stones, lying concealed during the day time and creeping about at night only. When discovered, they seem overcome with surprise, but they speedily recover and hurry away with considerable speed into holes and crevices. They are frequently found at the roots of trees under accumulations of dead leaves and rubbish. They require moisture, but must have well drained soil.

I have never found two species together, and my experience is that each species inhabits a tract of country to the exclusion of others. For instance, in Rangoon *T. rangunensis* is found ; proceeding 80 miles north, this species ceases and *T. sylvaticus* occurs. Similarly, further north *T. saxatilis* is alone found to occur. Reef and Double Islands each has its peculiar species. The species which so far as I know has the largest area of distribution is *T. indicus*, but the localities "Western Bengal and Southern India" attached to the few specimens I have been able to examine are so vague that no certainty can be attached to this point.

The *Thelyphoni*, when once you get into the way of finding them, are sufficiently abundant. I have frequently found twenty in one morning,

and, on one occasion, while visiting the lighthouse on Double Island, I secured 360 in three hours' work, myself and one man.

All the species I have met with emit a peculiar odour, more like aromatic vinegar than anything else I know, but more pungent. This odour emanates from a liquid which is ejected from an orifice near the root of the tail, and so powerful is it that it has frequently betrayed to me the position of the animal. On one occasion, when examining a live animal, I had a drop of the liquid injected into my eye, but it proved to be harmless.

These animals, it is hardly necessary to state, are quite incapable of inflicting injury to anything large than an insect. They have no sting and their cheliceres are very weak. A writer in the "Scientific American" sometime ago graphically described how a species common in Florida was in the habit of killing horses, so powerful was its sting. This is of course all nonsense.

I have not been able to discover anything regarding the breeding of these whip-scorpions. I have taken the very young only a-quarter of an inch in length and also what appeared to be pregnant females, but I could find neither eggs nor embryos in them. Mr. Fea, the energetic Italian naturalist now working in Burma, informs me, however, that he once discovered a female carrying a bunch of egg under her cephalothorax by the aid of her first pair of legs. This is all I know about the matter.

The two sexes of the *Thelyphoni* grow up absolutely alike till full grown. At this stage, the male, by some process upon which I am able, I am sorry to say, to throw no light, undergoes a transformation and emerges from it totally different from the female. That this is fact can admit of no doubt. Adult males are nearly as abundant as adult females, but half or three-quarter grown males with the external characters of the adult male, or with any characters at all not possessed by the female, are unknown. Once adult the sexes are as different as possible in appearance.

The immature animals resemble the adult female in all characters except colour, and in this latter respect the differences are not great, reds being replaced by olive-yellows or greens and black tints by pink ones.

In growing up, they seem to undergo numerous moults just like the scorpions and spiders.

The adult sexes are markedly different in all the species I know. The more marked difference is in the size and armature of the cheliceres, but there are minor differences, such as the grooving or entirety of the first lower abdominal segment, the size of the abdomen, and the colour of the cheliceres.

Adults of both sexes may be recognized by a certain redness and tumidity of the first lower abdominal segments not apparent in the immature animal.

I append a key to the eleven species known to me, and, in the plate, I have figured some parts of certain animals which will be of great assistance in the discrimination of the species.

In my descriptions I have only dwelt upon those characters which are of importance, chiefly the details of the cheliceres, the colours, and the important points of the cephalothorax and abdomen. I have not found the legs to vary in any appreciable degree in the different species, and therefore I have omitted them.

It will be noticed in the key that the females of some species cannot be discriminated from each other. I do not mean by this that the females are absolutely alike, but merely to express my inability to diagnose them in intelligible brief terms. Compared with each other they are sufficiently distinct, varying in shade of colour, shape of cheliceres, and in other points.

There are many immature specimens in the Indian Museum which I have hesitated to describe till mature animals are available. It is to be feared that many of the descriptions of these animals are based on young specimens, and, if so, they are useless, as the young of many species (which, when adult, are perfectly distinct) are absolutely alike.

On examining the specimens which the late Dr. Stoliczka referred to *T. angustus*, Lucas (J. A. S. B. 1873, pt. ii, p. 134), I found that the specimens were referable to the young of *T. assamensis*, *T. formosus*, and a species from Penang, the adult of which is unknown.

Key to the Species.

- a. With a sharp ridge between the central and lateral eyes.
 - a'. First joint of cheliceres with a lateral spine as well as a terminal one.
 - a''. Apophysis of the fourth joint of the cheliceres cylindrical, smooth on both edges, the outer edge rounded off at the tip (Fig. 13), *assamensis*, ♂.
 - b''. Apophysis of the fourth joint of the cheliceres sharply triangular, serrated on both edges, *assamensis*, ♀.
 - b'. First joint of cheliceres with only a terminal spine; second joint generally with 6 teeth.

- d''*. First lower abdominal segment divided longitudinally by a groove (Fig. 3 and 4).
- a'''*. Groove very deep and distinct (Fig. 3).
- a⁴*. Moveable finger of cheliceres festooned interiorly (Fig. 5); the terminal joint of the cheliceres of large size, broader than the fourth joint, *indicus*, ♂.
- b⁴*. Moveable finger of cheliceres simply rounded interiorly (Fig. 1F); the terminal joint of the cheliceres weak, much narrower than the fourth, *johorensis*, ♂.
- b'''*. Groove very shallow and indistinct (Fig. 4), *indicus*, ♀.
- d''*. First lower abdominal segment entire, with no trace of a groove, *johorensis*, ♀.
- b*. With no sharp ridge between the central and lateral eyes, this region being rounded.
- c'*. Apophysis of fourth joint of cheliceres long and cylindrical, smooth on both edges, suddenly and quadrately widened out on the terminal quarter of its length (Fig. 12), *andersoni*, ♂.
- d'*. Apophysis of fourth joint of cheliceres cylindrical, smooth on both edges, suddenly narrowed on the terminal half of its length (Fig. 10), *wood-masoni*, ♂.
- e'*. Apophysis of fourth joint of cheliceres absolutely cylindrical, the two edges being parallel throughout their length and smooth (Fig. 7).
- e''*. Length of abdomen and cephalothorax 1.3 inch, *insularis*, ♂.
- f''*. Length of abdomen and cephalothorax 1 inch, *formosus*, ♂.
- j'*. Apophysis of fourth joint of cheliceres approximately cylindrical but the edges more or less swollen towards their extremities (Fig. 9).
- g''*. Inner edge of the fourth joint of the cheliceres coarsely granulated; the inner edge of the third joint double the length of the front edge of the second, *binghami*, ♂.
- h''*. Inner edge of the fourth joint of the cheliceres smooth; inner edge of third joint equal to the front edge of the second.
- c'''*. The three hinder pairs of legs uniformly red, *saxatilis*, ♂.

- d'''*. Coxæ and femora of the three hinder pairs of legs reddish-brown, the other joints red.
- a⁴*. Apophysis of fourth joint gently swollen near the tip only, *rangunensis*, ♂.
- b⁴*. Apophysis of fourth joint greatly swollen over the terminal third of its length, *sylvaticus*, ♂.
- g'*. Apophysis of the fourth joint of the cheliceres triangular, sharply pointed, serrated on both edges (Fig. 2 and 8).
- i''*. First lower abdominal segment broadly rounded posteriorly (Fig. 3) all the legs red, *binghami*, ♀.
- j''*. First lower abdominal segment sharply protruding posteriorly (Fig. 4).
- e'''*. All the legs uniformly red, { *wood-masoni*, ♀.
insularis, ♀.
formosus, ♀.
- f'''*. Coxæ and femora of all the legs reddish-brown, the other portions red, *rangunensis*, ♀.
- y'''*. The three hinder pairs of legs uniformly red; the first pair reddish-brown, *saxatilis*, ♀.

1. THELYPHONUS ASSAMENSIS. Pl. II, Fig. 13.

Thelyphonus assamensis, Stoliczka, J. A. S. B. 1869, pt. ii, p. 205, pl. xix, fig. 1; 1873, pt. ii, p. 133, pl. xii, fig. 2.

Thelyphonus scabrinus, Stoliczka, J. A. S. B. 1873, pt. ii, p. 130, pl. xii, fig. 1.

Thelyphonus psittacinus, Butler, Cist. Ent. vi, p. 129, pl. v, fig. 2 (1873).

♂. Cheliceres and cephalothorax black; abdomen black tinged with red; legs and tail very deep red; below, first joint of cheliceres black with a rufous tinge; cephalothorax, abdomen, and legs deep blood-red.

♀. Similar in coloration to the male, but with the cheliceres slightly tinged with red.

Immature animal. Entirely dull reddish, the legs tinged with olivaceous brown.

Length 1·7 inches; cheliceres ·75 inch.

Many animals of this species are of a uniform madder-brown colour and this is probably the normal colour immediately after the change of skin. Analogous cases occur among the scorpions.

Structure. ♂. Cheliceres densely and coarsely granulated in every part; second joint with five teeth on the front and lateral edges, always distinct, two large spines below; third joint with a very long sharp spine below; fourth joint very large, with a small spine below and a

large apophysis on the interior-front corner, long and cylindrical, terminated with a large spine and furnished below with numerous teeth like a coarse file (Fig. 13); fifth joint much narrower than the fourth, fixed finger short and tringular almost smooth on both edges, movable finger long and curved, serrated below, in shape much as in Fig. 11; one sharp spine on the lower projecting angle of the joint; first joint of cheliceres below densely punctured and slightly wrinkled in places; the anterior process with a lateral spine as well as a terminal one; cephalothorax densely granulated all over with a very pronounced sharp ridge between the lateral and middle eyes.

First lower abdominal segment wrinkled in the middle, not divided by a groove; posterior edge well rounded.

Structure ♀. Cheliceres as densely granulated as in the male; second joint with five very distinct teeth in front and two spines below; third joint with a blunt spine on the interior edge and a long, sharp one below; fourth joint with a minute spine below and a triangular, pointed apophysis on the interior-front corner serrated on both edges (Fig. 8); fifth joint very narrow and feeble, fixed finger short and sharply triangular, serrated on both edges, movable finger long and sharply pointed, curved (Fig. 6), serrated on the inner edge; first joint of cheliceres below as in the male.

Cephalothorax as in the male. First abdominal segment below differing in no respect from that of the male.

Found throughout Assam and Sikkim, and the hill-ranges of Eastern Bengal and Cachar.

The late Dr. Stoliczka appears to have been ignorant of the great difference of structure between the sexes of these animals, and he describes the two sexes under different names. His name has priority over Mr. Butler's by four years. This species is widely distributed and appears to be common, and was consequently, we may suspect, known to the earlier writers on these animals, but to identify it with any of their names is now impossible. It will be well, therefore, to adopt Dr. Stoliczka's name instead of making fruitless attempts to find an earlier one.

2. *THELYPHONUS INDICUS*. Pl. II, Figs. 1—6.

Thelyphonus indicus, Stoliczka, J. A. S. B. 1873, pt. ii, p. 138, pl. xii, fig. 5.

„ *beddomei*, „ J. A. S. B. 1873, pt. ii, p. 142, pl. xii, fig. 6.

♂. Cephalothorax and abdomen dull chestnut-brown; cheliceres bright chestnut; legs and tail deep red below, cheliceres deep chestnut; abdomen, sternum, and legs bright chestnut. Length 1·3 inches.

♀. Similar to the male in colour.

Structure, ♂. Cheliceres strong; basal joint slightly punctured and wrinkled towards the front; second joint densely and coarsely granulated, the anterior portion rounded, with five or more sharp distinct teeth on the edge and two stronger ones on the lower surface; third joint thickly punctured all over and wrinkled towards the interior edge, which is angular and furnished with one spine, another spine below; fourth joint sparingly punctured all over and slightly granulated towards the origin of the apophysis which is triangular (Fig. 1) and slightly curved backwards, closely serrated on the outer edge and furnished with a few blunt spines on the inner; fifth joint large, broader than the fourth, sparingly punctured all over, fixed finger triangular, short and broad, finely serrated on the outer edge, the inner edge rough and furnished with a few small spines; movable finger slightly curved, the upper edge sinuated, finely serrated and with a blunt tooth near the tip (Fig. 5.), the lower edge simply curved and roughly serrated.

Cephalothorax densely granulated with a sharp sinuated ridge between the lateral and central eyes.

First lower abdominal segment of huge size, tumid, divided longitudinally by a groove and broadly rounded posteriorly (Fig. 3).

Structure, ♀. The abdomen much larger and the cheliceres shorter and slighter; the apophysis of the fourth joint of the cheliceres is also much broader at the base, but of about the same length, and consequently much blunter; the first abdominal lower segment is pointed posteriorly and barely grooved (Fig. 4). The movable finger is also of a very different shape and size (Fig. 6).

An examination of the late Dr. Stoliczka's types and of some other specimens more recently acquired by the Indian Museum demonstrates that his *T. indicus* is the male and *T. beddomei* the female of the same species.

The number of teeth on the front edge of the second joint of the cheliceres varies much in this species as may be seen from the following enumeration of examples examined.

♂. 7 teeth on right; 5 on left with traces of 3 more.

♂. 6 on right one being bifid; 5 on left with trace of another.

♂. 6 on right; 5 on left.

♂. 6 on right; 5 on left.

♀. 7-teeth on each side (*T. beddomei*).

All the specimens I have examined came from Southern India and Western Bengal, but no precise locality is attached to them.

Mr. Butler identifies his *T. sepiaris* with this species (Ann. & Mag. Nat. Hist. ser. 4, vol. xii, p. 116), but as he gives *T. sepiaris* from Tonghoo and Ceylon, and allows *T. beddomei* to be a good distinct species,

I fear the matter is too involved for me to arrive at any conclusion on the subject without the examination of his type, and for this I have had no opportunities.

3. *THELYPHONUS JOHORENSIS*, n. sp., Pl. II, Fig. 11, ♂.

♂. Cheliceres very deep red; cephalothorax nearly black; abdomen deep red; legs deep madder, brighter towards the extremities; below, first joint of cheliceres deep red; abdomen, sternum and exinguinal joints of legs blood red. Length 1·2 inches; cheliceres ·5 inch.

♀. Similar in colour to the male; slightly smaller.

Immature animal. Cephalothorax and abdomen red, legs brighter, cheliceres bright coral-red.

Structure, ♂. First joint of cheliceres densely punctured all over; second densely punctured, with six teeth on the anterior and lateral edges and two strong spines below; third densely punctured all over, with a very strong spine below; fourth joint densely punctured, with a long recurved triangular apophysis, serrated on the outer edge, and with a few teeth on the outer; fifth joint (Fig. 11) weak, narrower than the fourth, sparingly punctured, fixed finger serrated on the outer edge, with a few spines on the outer and down the side of the joint; movable finger weak, serrated on the inner edge, with a few spines on the lower edge.

Cephalothorax densely granulated all over, the space between the central and lateral eyes ridged.

First lower abdominal segment deeply grooved longitudinally (Fig. 3), extremely swollen large and rounded.

Structure, ♀. Similar to the male, but the apophysis of the fourth joint of the cheliceres shorter and broader at base; first lower abdominal segment without a longitudinal groove, and pointed posteriorly.

I have much pleasure in naming this species after the territory of the Sultan of Johore, where Mr. Wood-Mason discovered it.

4. *THELYPHONUS ANDERSONI*, n. sp., Pl. II, Fig. 12.

♂. Cephalothorax and cheliceres dark red, the legs paler red, the abdomen of intermediate colour; below, cheliceres dark red; abdomen, sternum and exinguinal joints of legs pale red; tail rather paler than the legs. Length 1 inch.

♀. Similar in colour to the male and of same size.

Immature animal. Unknown.

Structure, ♂. Cheliceres smooth with a very few minute punctures; first joint normal; second with a few obsolete teeth on the anterior and lateral edge and two strong spines below; third with a

sharp tooth on the lower surface; fourth with an indistinct spine on the lower edge and with a long apophysis on the interior angle. This apophysis is about the same length as the joint to which it is attached, perfectly cylindrical for three-quarters of the length, and suddenly widened out on the terminal quarter of its length to a width half as wide again as the cylindrical portion and terminating in a single recurved spine (Fig. 12); fifth joint feeble, narrower than the fourth, the interior edge toothed and furnished with hairs, the exterior edge of the fixed finger serrated; movable finger curved, sharply pointed, furnished with hairs and serrated below. Cephalothorax densely granulated, except on a portion between the lateral and central eyes, which is smooth and tumid but not ridged. First lower abdominal segment large, broadly sinuated behind, but not grooved.

Structure, ♀. Differs from the male in the structure of the cheliceres and first lower abdominal segment. Second joint of cheliceres with five distinct teeth, one on the middle of the anterior edge and four on the lateral, the foremost, situated at the angle of the two edges, being twice as large as the others, which are all of equal size, two small spines on the lower surface; third joint with a small tooth on the interior edge and one below; fourth joint with a short and sharply triangular apophysis, both edges serrated; fifth joint as in the male.

The first lower abdominal segment is longer and pointed posteriorly.

I have much pleasure in naming this species after Dr. John Anderson, the late Superintendent of the Indian Museum, who discovered it in Upper Burma. The male was taken in the second defile of the Irawadi river and the female on Pudeepyo mountain. Both are preserved in the Indian Museum.

The only female of this species is much mutilated, but I have described it to the best of my power. I regret, however, to have to leave it out of my key; when writing which I had not access to the specimen.

5. *THELYPHONUS WOOD-MASONI*, n. sp., Pl. II, Fig. 10.

♂. Cheliceres and cephalothorax pitchy-black; abdomen black tinged with red; legs blood-red; tail like the legs; below, first joint of cheliceres dark reddish-brown; legs and sternum with first abdominal segment blood-red, remainder of abdomen darker red.

♀. Similar to the male in colour.

Immature animal. Cheliceres coffee-brown, cephalothorax and abdomen dull rufous, the legs dull reddish vandyke-brown.

Length, male 1 inch; female, .95.

Structure, ♂. Cheliceres very sparingly punctured and nearly smooth all over, the exterior angle of the second joint transversely

wrinkled; second joint with 3-6 obsolete teeth on the anterior and interior edges and two blunt spines below; third joint with one spine below, the interior edge equal in length to the anterior edge of the second joint; fourth joint very broad, no spine below, with a long apophysis springing from the antero-lateral corner, the first half cylindrical and broad, the terminal half about half the thickness of the first and constricted in the middle, quadrately terminated and furnished with a small spine at the end (Fig. 10), the inside of the apophysis at the end with a large rounded process; fifth joint large, rounded, broader than the fourth joint, the inner edge scooped out to receive the rounded process on the apophysis of the fourth joint, causing the fixed finger to stand out as a cylindrical tooth serrated on both edges; movable finger moderately curved, serrated on the inner edge.

Cephalothorax densely granulated, the space between the anterior and the lateral eyes tumid.

Structure, ♀. Cheliceres with the first joint normal; second with five teeth on the anterior and lateral edges and two spines below: third joint with a lateral spine and one below; fourth with a spine below and a sharply-pointed triangular apophysis serrated on the inner edge and with 3 spines on the outer; fifth joint weak, narrower than the fourth, the fixed finger sharply triangular and serrated on both edges, the movable finger gently curved and serrated on the inner edge.

The cheliceres, as in the male, are nearly smooth, being very slightly punctured in a few places only.

Described from specimens taken on Muleyit mountain in Tenasserim and now in the Indian Museum. I have named it after Mr. J. Wood-Mason, the energetic Superintendent of the Indian Museum.

6. *THELYPHONUS INSULARIS*, n. sp., Pl. II, Figs. 7, 8.

♂. Cheliceres, cephalothorax, and abdomen deep black; legs and tail bright red; below, the first joint of cheliceres deep red, the other joints black, abdomen and legs bright red. Length 1·3 ins.; cheliceres ·75 ins.

♀. Of the same colour as the male. Length 1·3, chel. ·5 in.

Immature animal. Fourth and fifth joints of the cheliceres pink, second and third pinkish-brown; cephalothorax and abdomen greenish; coxal and femoral joints of legs pale greenish-brown, the remaining joints and the tail pale orange-yellow; below, first joint of cheliceres pale red, the other joints, and the legs, of the same colour as the upper surface, abdomen pale greenish-brown. With age the colours become firmer and the changes to the adult stage are very gradual. In half-grown specimens the legs are nearly uniform red and the cheliceres becoming blackish.

Structure, ♂. Second joint of cheliceres punctured all over, granulated and wrinkled at the anterior lateral corner, teeth on the interior and anterior margins indistinct, very variable in number and in all cases small and obsolete, no distinct spine below. Third joint punctured all over and coarsely granulated on the inner edge, with a spine below. Fourth joint with very few punctures, nearly smooth, apophysis long and cylindrical, terminated with two blunt teeth and with a large rounded process interiorly near the end (Fig. 7). Fifth joint very large and round, very nearly smooth, fixed finger short, triangular with a broad base, serrated on both edges, movable finger rather shorter than the fifth joint, serrated and sinuated within (Fig. 5). First joint beneath very sparingly punctured.

Cephalothorax granulated all over and transversely wrinkled behind the central eyes.

First lower abdominal segment smooth in the middle, not divided longitudinally by a groove.

Structure, ♀. The upper surface of cheliceres sparingly punctured throughout, 2nd joint with five very distinct teeth on the front and lateral edges, of which the two on the front edge are the largest, two teeth on the lower surface; third joint with a tooth on the interior edge and one below; fourth joint with a tooth below, the apophysis triangular, finely serrated on the outer edge, with two or three teeth on the inner (Fig. 8). Fifth joint narrower than the fourth, fixed finger sharply triangular, serrated on the outer edge, also on the inner edge nearly down to the bottom of the joint; movable finger shorter than fifth joint, gently curved throughout and serrated interiorly.

Cephalothorax and other parts, as in the male, except the first lower abdominal segment, which is pointed posteriorly.

This species is remarkable for the huge cheliceres of the adult male. It is common on Double Island at the entrance of the Moulmain River, to which island it appears to be confined, for on the opposite coast of the mainland *P. formosus* only is found. This island, which is crowned by a lighthouse, is very rocky, and only a few acres in extent. Some soft soil is found here and there under the rocks and under the bricks used for the staircase up to the summit of the island, and under these this animal occurs in incredible numbers.

7. THELYPHONUS FORMOSUS.

Thelyphonus formosus, Butler, Ann. and Mag. Nat. Hist. ser iv, vol. x, p. 201, pt. xiii, f. H.

„ „ Stoliczka, J. A. S. B. 1873, p. 137, pt. xii, f. 4.

♂. Cheliceres shiny-black; cephalothorax black slightly tinged

with red; abdomen reddish-brown tending to black; legs entirely dark red; lower surface dark chestnut, the first joint of the cheliceres much deeper; tail paler than the legs. Length 1 inch.

♀. Similar to the male in colour, and somewhat larger.

Immature animal. Cheliceres brownish-red turning to almost pure red at the end; cephalothorax black; abdomen olivaceous-brown: first three joints of all the legs olive-green; remainder of the legs and the whole lower surface pale reddish-yellow, darker on the first joint of the cheliceres.

Structure, ♂. Cheliceris very sparingly punctured all over, the second joint with a few wrinkles across the exterior portion, and with five more or less obsolete teeth on the anterior and interior edges; two spines on the lower surface; third joint with one spine below; fourth joint with a minute spine below and a long cylindrical apophysis on the interior-front angle, terminated below by a bifid tooth, and with a large rounded tubercle within; fifth joint large, broader than the fourth with a spine beneath, the fixed finger very short and triangular, serrated on both edges; movable finger sharp and curved (Fig. 11), finely serrated interiorly.

Cephalothorax finely granulated all over; space between lateral and frontal eyes swollen but not ridged.

First abdominal segment below smooth, not divided, broadly rounded posteriorly.

Structure, ♀. Second joint of cheliceres with five very distinct teeth on the front edge and two spines below; third joint with a spine below; third joint with a minute spine below and a short, bluntly-triangular apophysis on the interior-frontal angle, serrated interiorly and with a few teeth on the outside; fifth joint weak and narrow, the fixed finger triangular, sharply pointed and serrated on both edges, the movable finger weak, sharply curved and serrated within.

Cephalothorax as in the male.

First abdominal segment below smooth, the middle posterior portion abruptly lengthened.

Found in the neighbourhood of Moulmein in Tenasserim, where it appears to be common.

8. *THELYPHONUS BINGHAMI*, n. sp.

♂. Cheliceres and cephalothorax deep black; abdomen black tinged with red; legs bright red; below, first joint of cheliceres and the abdomen deep red, legs bright red.

♀. Of the same colour as the male, but the cheliceres strongly tinged with red.

Immature animal. First and second joint of cheliceres reddish-brown, the others coral-red; cephalothorax and abdomen dark brown; first three joints of all the legs olive-green, the others pale yellowish-red; below, the cephalothorax and abdomen reddish-brown.

Length 1.1 inches; cheliceres, ♂ .55; ♀ .45 inch.

Structure, ♂. Cheliceres sparingly granulated and punctured all over. Second joint with five ill-defined teeth on the front and lateral edges and two small spines below; third joint very long and cylindrical with one spine below; fourth joint long, the inner side granulated; with a blunt spine below and a long cylindrical apophysis on the anterior-lateral corner, slightly constricted in the middle and enlarged at the tip (Fig. 9) terminated with a rather sharp spine and a tumid process interiorly; fifth joint as broad as the fourth, serrated and festooned on the inner edge; fingers remarkably small, the fixed one triangular, nearly smooth on the inner edge, serrated on the outer, the movable one gently curved and serrated interiorly.

Cephalothorax minutely and densely granulated, the space between the lateral and frontal eyes barely tumid.

First lower abdominal segment entire, elevated and projecting posteriorly.

Structure, ♀. Cheliceres as in the male, but the second joint with five sharp and well-defined teeth, one on the anterior edge and four on the inner lateral edge; apophysis of fourth joint triangular with a few large spines on the inner edge and closely serrated on the outer; the fifth joint is much narrower than the fourth but the two fingers are the same as in the male. The third joint is much shorter and broader than the same one in the male and the whole cheliceres are shorter and stouter.

Cephalothorax exactly as in the male.

First abdominal segment entire, and rounded posteriorly as in the male.

The males and females of this species approach each other very closely in structure with regard to the cephalothorax and abdomen and the only point of distinction lies in the cheliceres.

This species is very abundant on Reef Island at the entrance of the Tavoy river in Tenasserim. It is a densely wooded island crowned by a small lighthouse. It is probably this species which Mons. Simon records from Tavoy and not *T. formosus*.

I have much pleasure in naming this species after Major C. T. Bingham, of the Forest Department of India, who has greatly assisted me in collecting these obscure animals.

9. *THELIPHONUS SAXATILIS*, n. sp.

♂. Cephalothorax, cheliceres, and abdomen black; first pair of legs reddish-black, except the tarsal joint, which, with the three other pairs of legs, is bright red; tail reddish-brown; below, the first joint of cheliceres black tinged with red; sternum and base of legs red; legs the same colour as the superior surface; abdomen reddish brown.

♀. Resembles the male in colour.

Immature animal. Cheliceres reddish-brown turning to pink on the last two joints; cephalothorax and abdomen dark olive-brown; first pair of legs olive, except the tarsal joint, which, with the three other pairs of legs, is pale red; below, uniform pale red, except the base of the cheliceres, which is reddish-brown.

Length 1.1 inch; cheliceres of male, .5.

Structure, ♂. Second joint of cheliceres punctured all over, the exterior-front corner wrinkled, the anterior and lateral edges with a few obsolete teeth, varying in number, one spine below; third joint punctured on the upper surface, granulated on the inner, and one blunt spine below; fourth joint nearly smooth, merely with a very few punctures, no spine below, apophysis long and cylindrical, constricted in the middle, rather swollen at the end with a tumid process on the inner side near the tip (Fig. 9); fifth joint large, nearly entirely smooth, fixed finger short and triangular, serrated on the outer edge, nearly smooth on the inner; movable finger rather long, curved throughout, the inner edge festooned and serrated.

Cephalothorax densely granulated, the space between the lateral and frontal eyes rather swollen.

First lower abdominal segment entire, rounded posteriorly.

Structure, ♀. Cheliceres much shorter than in the male but similarly punctured, etc.; second joint with five sharp distinct teeth on the front and internal edges and two spines below; third joint with one long spine below; fourth joint with a spine below and a triangular apophysis with a few spines or teeth on the inner edge and densely serrated on the outer; fifth joint narrow and feeble, fixed finger triangular, serrated on both edges, movable finger curved, sharply pointed and serrated on the inner surface.

First lower abdominal segment entire, sharply protruding posteriorly in a blunt point.

This species is very common at Thayetmyo in Burma being found under stones and bricks and in mud walls. Mr. D. K. Macdonald of the Public Works Department collected large numbers of this animal for me at that place.

10. *THELYPHONUS RANGUNENSIS*, n. sp.

♂. Cephalothorax, cheliceres, and abdomen deep black; coxæ and femora of all the legs reddish brown, remainder of legs deep red; beneath, the cheliceres dark reddish-black; sternum and legs deep red; abdomen deep reddish-brown.

♀. Of precisely the same colour as the male.

Immature animal. Cheliceres deep reddish-brown turning to red at the tips; cephalothorax and abdomen nearly black; coxæ and femora of all the legs and the tibial joint of the first pair of legs deep olive-green, remainder of legs pale red.

Length 1 inch; cheliceres, .45 in the male, .35 in the female.

Structure, ♂. Second joint of cheliceres sparingly punctured, with a few obsolete teeth on the front and interior margins and two spines below, of which one is very large and one very small; the exterior upper corner wrinkled; third joint rather closely punctured on the upper and outer sides, granulated within, with one tooth below; fourth joint nearly smooth, very broad, no spine below, apophysis very long, cylindrical, and of nearly equal width throughout, slightly wider near the extreme tip; fifth joint large, nearly smooth, fixed finger triangular, serrated on both edges, movable finger curved, sharp-pointed, and serrated within.

Cephalothorax densely granulated all over, the space between the lateral and frontal eyes slightly prominent and obsoletely ridged.

First lower abdominal segment entire, with the margin posteriorly rounded.

Structure, ♀. Cheliceres short; second joint with two spines below and five sharp, distinct ones on the front and inner edges, sparingly punctured all over but not wrinkled; third joint sparingly punctured all over with a spine on the inner surface; fourth joint with a few punctures, a spine below, and a triangular apophysis with a few large teeth on the inner edge and serrated on the outer edge; fifth joint sparingly punctured and serrated on the inner edge, fixed finger triangular and serrated on both edges, movable finger short and curved and serrated within.

Cephalothorax as in the male.

First abdominal segment below sharply produced posteriorly, entire.

This species is very common in Rangoon and the whole district round, being found under old timber, stones, and bricks.

11. *THELYPHONUS SYLVATICUS*, n. sp.

♂. Cheliceres pitchy black; cephalothorax and abdomen dull

black; first pair of legs and the coxæ and femora of the other legs very dark red, remainder of the legs bright red.

♀. The adult female is unknown, but will, without doubt, be found to have the same coloration as the male in respect to the legs.

Immature animal. Cheliceres pinkish brown; cephalothorax and abdomen dull blackish; coxæ and femora of all the legs deep olive, the other parts of the legs pale rufous.

Length .9 inch; cheliceres, .4 inch.

Structure, ♂. Cheliceres very slightly punctured, nearly smooth; second joint wrinkled on the exterior front corner with a few obsolete teeth on the front and interior edges, varying in number, one spine below; third joint without any spine; fourth joint broad with no distinct spine below, apophysis long, the first half very narrow and cylindrical, suddenly widening out to double the width on the terminal third; a tumid process on the interior surface near the tip; fifth joint fairly large, greatly sinuated on the interior edge, fixed finger triangular, smooth on the inner edge, serrated on the outer; movable finger sharply curved, and pointed, serrated on the inner edge.

The cephalothorax is densely granulated and the first abdominal segment entire and rounded posteriorly.

This species which is remarkable for the colour of its legs is no doubt common in the Tharrawaddy District of Burma, but I only procured an adult male and an immature animal of it, the former at Zigon, and the latter at Minhla. They were found in forest.

EXPLANATION OF PLATE II.

- Fig. 1. Apophysis of the fourth joint of the cheliceres of *T. indicus* ♂.
 " 2. " " " " " " " *T. indicus* ♀.
 " 3. First lower abdominal segment of *T. indicus* ♂.
 " 4. " " " " " " " *T. indicus* ♀.
 " 5. Terminal joint of cheliceres of *T. indicus* ♂.
 " 6. " " " " " " " *T. indicus* ♀.
 " 7. Apophysis of the fourth joint of the cheliceres of *T. insularis* ♂.
 " 8. " " " " " " " *T. insularis* ♀.
 " 9. " " " " " " " *T. sawatilis* ♂.
 " 10. " " " " " " " *T. wood-masoni* ♂.
 " 11. Terminal joint of cheliceres of *T. johorensis* ♂.
 " 12. Apophysis of the fourth joint of the cheliceres of *T. andersoni* ♂.
 " 13. " " " " " " " *T. assamensis* ♂.

III.—*Notes on Indian RHYNCHOTA ; HETEROPTERA, No. 5.*

By E. T. ATKINSON, B. A.

[Received, May 18th ;—Read June 6th, 1898.]

Subfamily, ACANTHOSOMINA, Stål.

Oefvers. K. V.-A. Förh. (3), p. 32, 39 (1872): En. Hem. v, p. 108 (1876):—*Acanthosomida*, Stål, Hem. Afric., i, p. 33, 219 (1864).

a, b, c, as in Subfam. *Pentatomina* (J. A. S. B., pt. ii, p. 192, 1887).

(*d.*) Tarsi 2-jointed: scutellum not reaching the middle of the dorsum of the abdomen, generally very narrow at the apex; and furnished with frena extended almost to the apex: tibiæ obtusely rounded, rarely furrowed. It contains those genera of the family *Pentatomidæ* of Dallas which have the scutellum triangular, subequilateral, or not much longer than broad, not reaching or barely extending beyond the middle of the dorsum of the abdomen, the apical part placed behind the frena, generally small, short, and narrow, the frena generally extended for a distance towards the apex of the scutellum, rarely reaching only the middle of the scutellum, apical margin of corium straight, rarely rounded towards the exterior apical angle, tibiæ obtusely rounded, and the sixth ventral segment, in ♀, rather strongly sinuated at the apex in the middle before the genital valvules.

Genus MICRODEUTERUS Dallas.

List Hem. i, p. 299 (1851); Walker, Cat. Het. ii, p. 390 (1868): Stål, Oefvers. K. V.-A. Förh., p. 640 (1870): En. Hem., v, p. 110, 112 (1876):—*Acanthosoma*, pt., Herr. Schöff, Wanz. Ins., viii, p. 5 (1848).

Body elongate-ovate: head large, broad, gradually sinuately narrowed behind the middle, sides anteriorly parallel or barely diverging, apex broadly and obtusely rounded, tylus and juga subequal in length: antennæ 5-jointed, basal joint short and stout, not extending beyond the apex of the head, second joint minute, third joint largest, nearly as long as the two following taken together, fourth longer than the fifth: rostrum rather long, reaching the base of the ventral spine; 2 and 3 joints about equal, the fourth shorter, basal joint half concealed within the head: pronotum anteriorly and sides distinctly margined, margins narrowly elevated and smooth, unarmed: scutellum rather small, longer than broad; frena not extending beyond the middle of the scutellum: membrane with longitudinal veins: mesostethial lamina reaching the head: sixth ventral segment, in ♀, furnished, towards the

sides at the anterior margin, with a small cavity or hollow; pectus with a strong ridge, which is more elevated anteriorly, and cut off obliquely at its posterior extremity to make room for the ventral spine which is short, scarcely passing the posterior coxæ.

295. MICRODEUTERUS MEGACEPHALUS, Herr. Schöff.

Acanthosoma megacephalum, Herr. Schöff., Wanz. Ins., viii, p. 5, t. 251, f. 783 et B (1848), ♀.

Microdeuterus megacephalus, Stål, Oefvers. K. V.-A. Förh., p. 640 (1870); En. Hem., v, p. 112 (1876).

♀. Entirely dark ochreous-yellow; finely, impressly punctured: base and apex of scutellum red-brown, the base with four yellow spots (sometimes obsolete): the pronotum somewhat red-brown towards the margin and in the middle: spots on the posterior part of segments of the connexivum and its posterior prolongation, brown with a violet tint: beneath unicolorous: rostrum reaching the end of the second ventral segment; the ventral spine extending as far as the base of the first pair of feet (*Herr. Schöff.*). Stål notes that the rostrum, at least in the ♂, reaches somewhat the apex of the third ventral segment: the venter with a median ridge is continued up to the apex of the sixth segment, which, in the middle, is a little shorter than the three preceding taken together, and somewhat obtuse-angularly emarginate at the apex: lower margin of the genital segment clothed with long, dense hairs, lateral lobes gradually acuminate. Long, 12 mill.

Reported from Bengal, Calcutta, Sikkim (mihi).

296. MICRODEUTERUS DALLASI, n. sp.

Microdeuterus megacephalus, Dallas (neo Herr. Schöff?), List Hem., ii, p. 300, t. 10, f. 4 (1851): Walker, Cat. Het. ii, p. 390 (1867): Stål, Oefvers, K. V.-A. Förh., p. 640 (1870); En. Hem., v., p. 113 (1876).

Differs apparently chiefly in the spinose posterior prolongations of the connexivum: these are present, but are much less produced.

Reported from N. India.

Genus ACANTHOSOMA, Curtis.

Brit. Ent. i, p. 28 (1824): Dallas, pt, List Hem. i, p. 198, 303 (1851); Walker, Cat. Het., ii, p. 392 (1867): Stål, Oefvers, K. V.-A. Förh., p. 368 (1870); (3) p. 39 (1872); En. Hem., ii, p. 61 (1870); v, p. 110, 113 (1876): Distant, Biol. Centr. Am. Rhyn., p. 100 (1879).

Head punctured, small or moderate, flat, triangular, gradually narrowed, narrow at the apex, with the tylus longitudinally impressed;

pronotum levigate, sides immarginate, process of the lateral angles not turning forwards, short, triangular, somewhat depressed: scutellum narrow at the apex, frena extended for a distance towards the apex, apical margin of corium straight: first joint of the antennæ extending beyond the apex of the head: mesostethial ridge high, laminated posteriorly, abruptly lower before the intermediate coxæ, not produced hindwards between them; not or only very slightly extending beyond the anterior margin of the mesostethium, more or less distinctly rounded at the apex: apical angles of the sixth abdominal segment in ♂ rounded at the apex.

297. ACANTHOSOMA PROXIMA, Dallas.

Acanthosoma proximum, Dallas, List Hem., i, p. 308 (1851): Walker, Cat. Het. ii, p. 388 (1867).

Acanthosoma proxima, Stål, En. Hem., v, p. 113 (1876); Distant, Scient. Res. 2nd Yarkand Miss., p. 7 (1879).

Above brownish or yellowish green: very like *A. hæmorrhoidalis*, Linn., the lateral angles of the pronotum are less prominent, rufous, punctured black: apex of scutellum, black (*Dallas*). Long, $15\frac{1}{2}$ —16 mill.

Reported from Murree (Panjáb): Rawal Pindi (mihi).

298. ACANTHOSOMA DISTINCTA, Dallas.

Acanthosoma distinctum, Dallas, List Hem., i, p. 304 (1851): Walker, Cat. Het. ii, p. 393 (1867).

Acanthosoma distincta, Scott, A. M. N. H. (4 s.) xiv, p. 290 (1874): Stål, En. Hem., v, p. 113 (1876): Reuter, Berlin Ent. Zeitschr., xxv, p. 75 (1881): Distant, Trans. Ent. Soc., p. 415 (1883).

♂. Above pale olive-green, rather thickly punctured with black, head pointed in front, finely punctured: pronotum with a transverse impunctate space towards the anterior margin; lateral angles prominent, subspinose, obtuse, ferruginous: scutellum brownish, becoming green towards the apex, with the apex itself whitish, membrane brownish, semitransparent, with a dark line at the base, surrounding the apical margin of the corium: abdomen above red, with the margins bright orange, with a black band at the junction of each segment: body beneath pale testaceous: abdomen with the emargination of the apical segment very deep reaching the middle of the abdomen; the margins spotted with black: legs pale greenish, with the tarsi fulvous. Antennæ rather long, pale greenish, with the two apical joints dusky ferruginous (*Dallas*). Long, 13 — $13\frac{1}{2}$ mill.

Reported from N. E. India, Murree (Panjáb), Darjiling, Japan.

299. ACANTHOSOMA DIFFICILIS Dallas.

Acanthosoma difficile, Dallas, List Hem., i, p. 304 (1851): Walker, Cat. Het. ii, p. 399 (1867): Stål, En. Hem., v, p. 113 (1876).

♂. Pale olive-green, tinted red and orange, punctured: head reddish; juga wrinkled and with a few black punctures: pronotum rather thickly punctured, black; anterior and lateral margins reddish, lateral angles prominent, deep red: scutellum deep orange, with numerous scattered black punctures, disc of corium thickly and rather finely punctured, outer margin orange, rather strongly punctured black: membrane transparent, nearly colourless: margins of abdomen not spotted: body beneath dark orange: abdomen with the apical segment not very deeply emarginate: legs ferruginous-orange: antennæ with the three basal joints somewhat ferruginous (*Dallas*). Long, 13—14 mill.

Locality unknown.

300. ACANTHOSOMA DUBIA, Dallas.

Acanthosoma dubium, Dallas, List Hem., i, p. 304 (1851): Walker, Cat. Het., ii, p. 399 (1867): Stål, En. Hem., v, p. 113 (1876).

♂. Closely allied to and hardly distinct from the preceding: differs in having the head anteriorly somewhat rounded: angles of pronotum less prominulous, rounded: third joint of the antennæ black at the apex (*Dallas*). Long, 13—14 mill.

Locality unknown.

301. ACANTHOSOMA LAEVICORNIS, Dallas.

Acanthosoma laevicorne, Dallas, List Hem., i, p. 311 (1851): Walker, Cat. Het. ii, p. 399 (1867).

♂, ♀. Above pale yellowish-olive: head triangular, pointed in front, with the tylus passing the juga, the surface slightly wrinkled, pronotum thickly and rather coarsely punctured; lateral angles produced into long, impunctate horns which are sometimes yellow, horns directed forwards and of the same thickness from the base to near the apex which is acute and slightly recurved: scutellum rather strongly but not very thickly punctured; hemelytra very thickly punctured membrane transparent, brownish: body beneath, orange or pale olive: abdomen impunctate, but very finely wrinkled towards the sides; apex sometimes bright red: legs and rostrum testaceous or pale alive: antennæ testaceous, with the third joint black, except at the base (*Dallas*). ♂, long, 15—16; ♀, 21 mill.

Locality unknown.

302. *ACANTHOSOMA FORFEX*, Dallas.

Acanthosoma forfex, Dallas, List Hem., i, p. 308 (1851); Walker, Cat. Het., ii, p. 394 (1867); Stål, En. Hem., v, p. 115 (1876); Distant, Scien. Res. 2nd Yarkand Miss., p. 7 (1879).

♂. Elongate, above pale olive-green, rather densely and strongly punctured black: head pale, with a few fine black punctures; the apex somewhat pointed, with the tylus longer than the juga; eyes black: pronotum with the lateral angles prominent, forming a short, obtuse spine on each side; two yellowish impunctate patches close to the anterior margin, the lateral margins and angles reddish brown: scutellum with the disc reddish brown, with a yellowish, impunctate, median, longitudinal line; the lateral margins and the apex olive-green: membrane transparent, brownish. Body beneath, pale greyish green, tinted with red: abdomen impunctate, obtusely ridged in the middle; sexual organs greatly developed, the lateral pieces produced into two curved processes of a bright orange colour, bearing a small brush of hair at their apices, and nearly as long as the abdomen: the internal pieces black at the tip: prostethium densely and finely punctured: legs pale yellowish-green, with the tips of the claws black: rostrum testaceous, extreme tip pitchy black: antennæ pale yellowish-green, becoming brown towards the apex (Dallas). Long, $12\frac{1}{2}$ mill.

Reported from N. India: Murree.

303. *ACANTHOSOMA ELONGATA*, Dallas.

Acanthosoma elongatum, Dallas, List Hem., i, p. 309 (1851); Walker, Cat. Het., i, p. 394 (1867); Stål, En. Hem., v, p. 115 (1876).

♀. Elongate, above yellowish-green, punctured with black: head slightly rugose, impunctate, somewhat pointed in front, with the tylus longer than the juga: eyes black: pronotum yellowish-green in front, reddish behind, coarsely and rather thickly punctured with black, with the exception of a transverse band near the anterior margin; lateral angles produced into strong, deep crimson spines, with the apex obtuse: scutellum coarsely but sparingly punctured with black, and with a reddish-brown, triangular mark in the middle of the base: coriaceous portion of the hemelytra reddish internally, the outer margin and the greater portion of the apex, yellowish-green; the whole surface densely and strongly punctured with black and somewhat rugose: membrane brownish transparent: body beneath, bright yellow, shining: abdomen impunctate, with a strong median ridge; sexual organs much developed, but much less so than in *A. forfex*; lateral processes bright red; pieces flat, yellow, widened, emarginate at the tip which is black: prostethium

with a few black punctures; posterior margin of the metastethium thickly and finely punctured: legs greenish-testaceous with tarsi dusky, and the tips of the claws black: tip of the rostrum, blackish; antennæ with the basal joint greenish-testaceous: the remainder brown, becoming darker towards the apex (*Dallas*). Long, $14\frac{1}{4}$ mill.

Reported from N. India.

304. ACANTHOSOMA (?) BINOTATA, Walker.

Acanthosoma binotata, Walker, Cat. Hct., ii, p. 395 (1867).

Testaceous, elongate-oval, roughly punctured; punctures brown: head elongate, smooth in front; tylus hardly extending beyond the juga: rostrum extending to the last coxæ; tips black: antennæ slender, less than half the length of the body; joints successively increasing in length; first extending a little in front of the head: pronotum in front with a smooth band, of which the fore border is a curved pale testaceous line; sides and a slender stripe, pale testaceous; hind angles forming two long, acute, slightly recurved, spines: scutellum with a slender pale testaceous stripe, on each side of which there is a brown patch; tip also brown: pectoral ridge well developed: abdomen beneath slightly ridged, with two incomplete macular brown stripes; spine extending to the intermediate coxæ: hemelytra clouded with brown, around a smooth, transverse, pale-testaceous spot on the disc; membrane cinereous (*Walker*). Long, $6\frac{1}{2}$ —7 mill.

Reported from India; differs from *C. punctata*, Dallas, by the thoracic spines.

305. ACANTHOSOMA ASPERA, Walker.

Acanthosoma aspera, Walker, Cat. Hct., ii, p. 395 (1867): Distant, *Scien. Res.* 2nd Yarkand Miss., p. 7 (1879).

Testaceous, elongate-oval, thinly and roughly punctured; punctures mostly black: head elongate; tylus extending very little beyond the juga: rostrum extending a little beyond the hind coxæ; tip black: antennæ slender, a little more than half the length of the body; first joint extending a little beyond the front of the head; second as long as the third; fourth a little shorter than the third; fifth black, testaceous towards the base, shorter than the fourth: hind angles of the pronotum forming two red, long, stout, acute, very slightly recurved and ascending, spines: pectoral ridge much developed: abdomen beneath slightly ridged; spine extending to the intermediate coxæ: legs rather slender: membrane cinereous (*Walker*). Long, 9— $9\frac{1}{4}$ mill.

Reported from India, Murree.

306. ACANTHOSOMA (?) TRUNCATULA, Walker.

Acanthosoma truncatula, Walker, Cat. Het., ii, p. 396 (1867).

Testaceous, broad, nearly oval, roughly punctured: head mostly smooth; tylus extending very little beyond the juga: rostrum extending to the last coxæ; tip black: antennæ slender, about half the length of the body; first joint extending beyond the front of the head; second as long as the third: pronotum with a smooth band in front, and with a slender paler stripe; hind angles forming two long, stout, hardly acute, directly diverging horns: pectoral ridge well developed: abdomen beneath smooth, slightly ridged; spine extending to the intermediate coxæ: legs rather slender: membrane cinereous (*Walker*). Long, 6½ mill.

Reported from India.

307. ACANTHOSOMA (?) IMMUNDA, Walker.

Acanthosoma immunda, Walker, Cat. Het., iii, p. 573 (1868).

Reddish testaceous, elongate-oval, roughly and rather thinly punctured: head elongate, triangular, blackish above, excepting the sides, which are reddish and slightly elevated: eyes red: antennæ testaceous, more than half the length of the body; first joint extending beyond the front of the head; second longer than the first and than the third; fourth a little longer than the third; fifth piceous, luteous at the base, longer than the fourth: pronotum with two stout acute spines which are black towards their tips and are nearly as long as half the breadth of the pronotum: scutellum with a black stripe, which is abbreviated towards the base: sternal ridge deep: ventral spine extending to the intermediate coxæ: legs testaceous, slender: membrane pale cinereous, with a broad blackish stripe (*Walker*). Long, 7½ mill.

Reported from India.

308. ACANTHOSOMA (?) ALATICORNIS, Walker.

Acanthosoma alaticornis, Walker, Cat. Het., iii, p. 573 (1868).

Tawny, elongate-oval, shining, roughly punctured: head elongate, slightly acute; sides reflexed: eyes piceous, not prominent: rostrum extending to the last coxæ; tip black: antennæ piceous, slender; first and second joints testaceous; first extending much beyond the head; second as long as the third; fourth longer than the third; fifth shorter than the fourth: pronotum pale testaceous along each side in front, with a broad testaceous band between the horns which are as long as the intermediate breadth and are broad and linear from the base to near the

tips, where they are black, dilated and recurved; scutellum less than half the length of the abdomen: pectoral ridge pale testaceous, extending to the head: abdomen ferruginous, pale testaceous along each side, black at the tip; beneath with a pale testaceous stripe; ventral spine pale testaceous, lanceolate: legs slender, pale testaceous: hemelytra pale testaceous towards the base and along the hind border, and with a large pale testaceous apical spot which extends to the costa; membrane brown: wings cinereous (*Walker*). Long, $11\frac{1}{2}$ mill.

Reported from India.

309. ACANTHOSOMA (?) NIGRICORNIS, Walker.

Acanthosoma nigricornis, Walker, Cat. Het., iii, p. 574 (1868).

Tawny, elongate-oval, roughly and thinly punctured, testaceous beneath: head slightly acute, transversely and finely striated; sides reflexed: eyes piceous, not prominent: rostrum extending to the intermediate coxæ, tip black: antennæ black, slender; first and second joints tawny; first extending much beyond the front of the head; second a little longer than the third; fourth longer than the second and than the fifth: pronotum with a transverse callus on each side in front; horns black, stout, shorter than the intermediate breadth, very slightly curved backward, tapering from the base to the tips, which are slightly rounded: scutellum very slightly ridged, less than half the length of the abdomen, much attenuated at the tip, which is rounded: pectoral ridge deep, extending to the head: abdomen black towards the tip above; ventral spine extending to the middle coxæ: legs testaceous, slender: hemelytra with a brown costal stripe, which widens towards the tip; membrane brown: wings brownish cinereous (*Walker*). Long $14\frac{1}{2}$ mill.

Reported from India.

Genus SASTRAGALA, Am. & Serv.

Hist. Nat. Ins. Hém., p. 155 (1843). Includes *Acanthosoma*, pt., Dallas, List Hem., i, p. 303 (1851): Stål, Oefvers. K. V.-A. Förh., p. 638 (1870); En. Hem., v, p. 110, 113 (1876).

Pronotum anteriorly levigate; within the levigate and more or less distinctly elevated apical margin with fewer punctures, which are placed in a row sometimes confused or here and there double; process of the lateral angles obtusely rounded, horizontal, not turning forwards: scutellum narrow at the apex: apical angles of sixth abdominal segment, in ♂, straight or somewhat acute, not rounded: mesostethial ridge not produced hindwards, not, or but very slightly; extending be-

yond the anterior margin of the prostethium, more or less distinctly rounded at the apex.

310. *SASTRAGALA UNIGUTTATA*, Donovan.

Cimes uniguttatus, Donovan, *Ins. Ind. Hem.*, t. 8, f. 5 (1800).

Acanthosoma uniguttatum, Dallas, *List Hem.*, i, p. 311 (1851); Walker, *Cat. Het.*, ii, p. 394 (1867).

Sastragala uniguttata, Stål, *En. Hem.*, v, p. 113 (1876); excl. syn. Distant, *A. M. N. H.*, (5 s.) iii, p. 45 (1879).

♂. Pronotum with acute spines, ferruginous; scutellum marked with a large white dot (*Donov.*).

Donovan's figure agrees best with the description of *S. heterospila*, Walker, except that the latter has a black band or line between the lateral angles.

Reported from Madras, Assam.

311. *SASTRAGALA LINEATA*, Dallas.

Acanthosoma (Sastragala) lineata, Dallas, *Trans. Ent. Soc.*, v, p. 194 (1849); Walker, *Cat. Het.*, ii, p. 396 (1867); Stål, *En. Hem.*, v, p. 115 (1876).

Above dusky testaceous, strongly punctured with brown: head yellow, with a brown line on each side of the tylus, and a row of brown punctures on each of the juga; eyes brown: pronotum with the lateral spines acute, slightly recurved, pitchy brown; a transverse band near the anterior margin, and a narrow longitudinal line along the middle of the pronotum impunctate, yellow: scutellum, yellowish brown, paler towards the apex, and with a yellow spot in the middle of the base: hemelytra dusky testaceous, thickly and strongly punctured, the apex yellowish; a short, transverse, impunctate, orange band, near the outer margin, considerably beyond the middle, directed towards, but not reaching, the internal angle; membrano transparent, faintly clouded with brown: abdomen above deep red, the margins yellowish; head pronotum and abdomen beneath, with the legs, rostrum and antennæ testaceous; the antennæ rather darker; ventral spino short, scarcely reaching the intermediate legs (*Dallas*). Body long, 7 mill.

Reported from Sikkim.

312. *SASTRAGALA BINOTATA*, Distant.

Sastragala binotata, Dist., *Trans. Ent. Soc.*, p. 353, t. 12, f. 12 (1887).

Apex above brownish ochraceous; corium with the lateral margins—widened into a spot in the middle—dull ochraceous, inwardly shaded blackish, membrane bronzy: head transversely wrinkled: antennæ

ochraceous, third joint much longer than the second: pronotum and scutellum sparingly and coarsely punctured, the corium more thickly punctate: lateral angles of pronotum produced into long, somewhat conical spines, their apices subacute, and very slightly reflexed hindwards: body beneath and legs ochraceous; apex of rostrum pitchy (*Dist.*). Long, 13; exp. angl. pron. 10 mill.

Reported from Sikkim (mihi).

313. *SASTRAGALA RUFISPINA*, Distant.

Sastragala rufispina, *Dist.*, *Trans. Ent. Soc.*, p. 325 (1887).

Body above dark ochraceous, pronotal angles purplish red: head finely and transversely wrinkled, apical part of tylus foveated and excavated: pronotum, scutellum and corium somewhat sparingly and coarsely punctate: lateral angles of the pronotum produced in obtusely pointed spines: membrane, pale hyaline, blackish at the base: body beneath very pale ochraceous, legs a little darker in hue: apex of the rostrum pitchy, reaching second abdominal segment; last abdominal segment with two small black spots at the apex: pronotal spines red, beneath as above (*Dist.*). Long, 17; exp. angl. pron., 11 mill.

Reported from N. India.

314. *SASTRAGALA MUSTELINA*, Distant.

Sastragala mustelina, *Dist.*, *Trans. Ent. Soc.*, p. 352 (1887).

Body above ochraceous; membrane pale brownish; connexivum with the segmental spines black: antennæ ochraceous, apical half of third joint infusate, third joint much longer than the second; head somewhat obscurely transversely wrinkled, eyes pitchy: pronotum, scutellum and corium coarsely punctate: lateral angles of the pronotum produced into long, straight, somewhat conical, subacutely pointed spines; body beneath, rostrum and legs coloured as above: extreme apex of rostrum pitchy (*Dist.*). Long, 13; exp. angl. pron., 11 mill.

Reported from Naga Hills (Assam).

315. *SASTRAGALA HETEROSPILA*, Walker.

Acanthosoma heterospila, *Walk.*, *Cat.*, ii, p. 894 (1867).

Testaceous, elongate-oval, roughly punctured: head and fore-part of the pronotum with a reddish tinge; elongate, tylus extending very little beyond the juga; rostrum extending a little beyond the hind coxæ; tip black: antennæ slender, about half the length of the body; first joint extending beyond the front of the head; second much shorter than the third;

fourth longer than the third: pronotum with a black band, which occupies the hind border and includes the hind angles; these form two long acute directly diverging spines: scutellum black, with a large luteous spot in the disc; tips whitish: pectoral ridge well developed: abdomen slightly ridged beneath; spine extending to the intermediate coxæ: legs rather stout: hemelytra black along the hind border and irregularly black along the outer border; membrane brown, cinereous along the outer border, including a white costal spot at its base (*Walker*). Long $9\frac{1}{2}$ mill.

Reported from the Panjab: Bunkoti in Jaunsar, 9000 feet (mihi).

316. SASTRAGALA PARMATA, Distant.

Sastragala parmata, Distant, Trans. Ent. Soc., p. 353 (1887).

Body above brownish-ochraceous; spines on pronotum reddish-brown; scutellum with a large cordate ochraceous spot, surrounded with blackish; antennæ ochraceous, 3-4 joints subequal in length, a little shorter than the fourth: eyes purplish-brown: pronotum sparingly and coarsely punctate, the lateral angles produced into long, thick, rounded spines, very slightly reflexed at the apices: scutellum with the median spot levigate, remainder coarsely punctate, apex ochraceous; corium coarsely punctate, with the lateral margin luteous and levigate: body beneath and legs ochraceous; apex of rostrum pitchy (*Dist.*). Long, 12; exp. angl. pron., 9 mill.

Reported from N. India.

Genus ANAXANDEA, Stål.

En. Hem. v, p. 110, 113 (1876).

Mesostethial ridge long, rather prominent to a distance before the anterior margin of the prostethium, with the apical part before the same margin prominulous, gradually narrowed or acuminate: process of the lateral angles of the pronotum turning outwards, slightly upwards and distinctly forwards, pronotum at the anterior margin with punctures arranged confusedly in somewhat like two rows; apical angles of the sixth segment of the abdomen, in ♂, somewhat obtuse.

317. ANAXANDRA RUFESCENS, Dallas.

Acanthosoma rufescens, Dallas, List Hem., i, p. 311 (1851); *Walker*, Cat. Het., ii, p. 399 (1867).

Anaxandra rufescens, Stål, En. Hem., v, p. 114 (1867): *Reuter*, Berlin. Ent. Zeitschr., xxv, p. 77 (1881).

♀. Head dull olive, impunctate, pointed in front, with the vertex

orange: pronotum with the anterior portion olive, rather coarsely but sparingly punctured with black, and with a broad, impunctate, orange band near the anterior margin; posterior portion ferruginous, rather thickly punctured with black; lateral angles produced into long, acute, red spines, which are directed a little forwards, but have the apex slightly turned back; the basal portion of these spines is coarsely punctured with black, the apex smooth. Scutellum ferruginous olive, sparingly and irregularly punctured with black; the apex testaceous: hemelytra thickly and rather strongly punctured with black, with the outer margin, as far as the submarginal vein, olive; membrane transparent, brownish: body beneath orange; pectus yellowish; abdomen with the posterior angles of the last segment, and the posterior margins of the intermediate and apical vulvar plates, bright red; legs pale yellowish olive, with the base of the femora and the tarsi orange-testaceous: rostrum short, testaceous: antennæ pale olive (*Dallas*). Long, 16—17 mill.

Reported from India, Darjiling (mihi).

318. ANAXANDRA CORNUTA, Dallas.

Acanthosoma cornutum, Dallas, Trans. Ent. Soc., v, p. 193, t. 19, f. 6 (1849); List Hom., i, p. 312 (1851); Walker, Cat. Het., ii, p. 394 (1867).

Anaxandra cornuta, Stål, En. Hem., v, p. 114 (1876).

♂, ♀. Above olive, slightly clouded with yellowish, rather thickly and strongly punctured: pronotum with the lateral angles strongly cornuted; the processes being more darkly coloured than the rest of the surface: the antero-lateral margins of the pronotum beneath are greenish: scutellum acute, slightly sinuated on each side, immediately before the apex; hemelytra thickly and strongly punctured; membrane brownish at the base, particularly at the internal angles: joints of the antennæ concolorous with the body, the apex, and sometimes the whole of the joints pitchy: legs pale brownish yellow, with the tibiæ and tarsi somewhat darker: ventral spine long, reaching as far as the base of the anterior legs.

♂. With the pronotal processes dark olive green, rounded at the apex, beneath flat, but not grooved: the membrane is pale and semitransparent; the abdomen above red, with broad whitish margins: the body beneath is pale ochraceous, with a reddish tinge towards the apex of the abdomen: ventral spine pale.

♀. With the pronotal processes pitchy, very acute, the apex recurved and tipped with bright orange, strongly channelled beneath; the membrane is brownish; the abdomen beneath pitchy brown, darkest at the apex, and palest on the outer margins and along the median ridge; ven-

tral spine pale, tipped with brown: pectus brownish, with the sternal ridge semitransparent; head beneath brownish (*Dallas*). Long, 13; breadth of pronotum 10 mill.

Reported from Sikkim (mihi).

319. ANAXANDRA NIGRO-LINEATA, Stål.

Anaxandra nigro-lineata, Stål, En. Hem., v, p. 114 (1876).

♀. Olivaceous-flavescent, sparingly punctured above; three apical joints of the antennæ, lateral margins and longitudinal line (anteriorly abbreviated, posteriorly fissured) on the head, longitudinal line on the pronotum before the middle, apical interior spot on the last segment of the connexivum, basal band (posteriorly bisinuate) on the last dorsal segment, and a transverse line on the mesopleuræ, black: flavescent spot on the scutellum, exteriorly and posteriorly margined with black; exterior margin of scutellum punctured in rows at that spot: lateral angles of the pronotum produced in a very long process, sparingly punctured, smooth towards the apex, acuminate and slightly recurved at the apex: dorsum of abdomen sub-sanguineous: membrane slightly infusate, exterior margin (base excepted) deeper fuscous: wings infusate (*Stål*). Body long, 17; breadth of pronotal processes, $18\frac{1}{2}$ mill.

Reported from India, Darjiling (mihi).

In form and punctuation very like *A. cornuta*, Dallas: pronotal processes longer and turning less upwards.

320. ANAXANDRA SIGILLATA, Stål.

Anaxandra sigillata, Stål, En. Hem. v, p. 114 (1876).

♀. Closely allied to *A. nigro-lineata*, Stål, but smaller, pronotal processes shorter, above black, anteriorly at the apex more strongly rounded, membrane more obscure, exterior limb pale at the base, margins of the head concolorous, and pronotum without a black longitudinal line; spot on the scutellum at the very narrowly blackish anterior margin sparingly punctured (*Stål*). Long, 13; breadth of pronotal processes, 10 mill.

Reported from India.

321. ANAXANDRA NIGRO-CORNUTA, Reuter.

Anaxandra nigro-cornuta, Reuter, Berlin. Ent. Zeitschr., xxv, p. 77 (1881).

♀. Olivaceous, greenish, head a little, pronotum and scutellum sparingly irregularly, and hemelytra more densely punctured black; head, sutures towards the base of the clypeus, and two approximated

dots on the margin of the vertex, black; apical half of third joint of the antennæ and two last joints, black; anterior band on the pronotum and its sides posteriorly towards the angles, base of scutellum, clavus towards the apex and corium at the claval suture, ferruginous; lateral angles of pronotum produced outwards in a very long horn, entirely black up to the sparingly punctured apex, acuminate at the apex and distinctly recurved, convex on the anterior margin; this horn is as long as the base of the scutellum, slightly rising: membrane smoky with a small whitish dot at the base of the exterior margin: dorsum of abdomen red, apex black, the dorsal genital lobes, in ♀, however, have a red spot; posterior angles of segments of connexivum, black; body beneath pallid. Horns of pronotum beneath olivaceous-virescent-ferruginous, punctured black; pectus palely flavescent, colour verging somewhat into ruddy; prostethium punctured, anterior lateral margin virescent, meso- and meta-stethium somewhat smooth: inferior margin of mesostethial plate rounded: venter slightly rufescent, apical angles of the segments of the connexivum, narrowly black: dorsal genital lobes, in ♀, obliquely rounded outward, there before the base abruptly strongly oblique, slightly concave (*Reuter*). Long, $13\frac{1}{2}$ mill.

Reported from Darjiling.

322. *ANAXANDRA FULVICORNIS*, Distant.

Anaxandra fulvicornis, Dist., Trans. Ent. Soc., p. 354 (1887).

Body ochraceous, with an olivaceous tinge: anterior lateral margins of the head, a median narrow longitudinal stripe commencing before the apex of the head and ending on the disc of the pronotum, and the lateral margins of the scutellum (united before the apex), black: basal joint of antennæ ochraceous: pronotum with the disc posteriorly coarsely punctate, lateral angles produced into long, slightly ascending, and directed forwards, dull-luteous spines, of which the apices are very slightly reflexed and subacute: basal two-thirds of scutellum luteous, posteriorly rounded, and margined black: corium coarsely punctate and rugulose: membrane brown: body beneath and legs ochraceous: mesonotum with an oblique black line on each side. Closely allied to *A nigro-lineata*, Stål, but differs in the smaller expanse of the pronotal angles (*Dist.*). Long, 15; exp. angl. pron. 14 mill.

Reported from Sikkim.

323. *ANAXANDRA TAURIFORMIS*, Distant.

Anaxandra tauriformis, Dist., Trans. Ent. Soc., p. 354 (1887).

Body above bright castaneous: lateral margins of the head, ante-

rior and lateral margins and posterior disc of the pronotum, lateral margins of the scutellum, lateral margins of the corium and the membrane, ochraceous: 1-2 joints of the antennæ, ochraceous: head transversely wrinkled and with a few dark punctures: eyes greyish-brown, margined inwardly ochraceous: pronotum on the disc sparingly and coarsely, on the anterior margin thickly, punctate; humeral angles produced upwards and forwards into long spines of which the apices are distinctly truncately reflexed hindwards, these spines are sparingly punctate for about half their length: scutellum sparingly and coarsely punctate: corium thickly punctate: abdominal spines above and beneath castaneous, but beneath inwardly margined blackish: body beneath and legs ochraceous (*Dist.*). Long, 15; exp. angl. pron. $14\frac{1}{2}$ mill.

Reported from Khasiya Hills (Assam).

324. ANAXANDRA HAMATA, Reuter.

Anaxandra hamata, Reuter, Berlin. Ent. Zeitschr., xxv, p. 78 (1881).

♂. Very like *A. rufescens*, Dallas, differs however in the lateral horn of the pronotum, also (in ♂) in anterior margin before the apex itself, being a little more distinctly convex, entirely sanguineous, and especially in the structure of the genitalia in the ♂. First genital segment about one-third shorter than preceding, apical margin slightly sinuate, second segment uncovered on the margin, straight in the middle, with two small bands subvertically placed in the middle itself; shortly but densely fulvous-pilose, apical angle produced in a long, somewhat incurved horn, this horn furnished at the apex with a densely fulvous pilose fascicula, its exterior margin as long as the lateral margin of the preceding segment, inferior margin as long as the margin of the apical segment: *styli* briefly biramose at the apex, upper ramus narrow and acutely acuminate, apex somewhat curved, inferior broader and more obtuse, abruptly dentately contracted at the apex (*Reuter*). Long with membrane 15 mill.

Reported from Darjiling.

325. ANAXANDRA COMPACTA, Distant.

Anaxandra compacta, Dist., Trans. Ent. Soc., p. 355 (1887).

Body above ochraceous, with an olivaceous tinge; head with the basal margin, a spot behind each eye, and the margins of the tylus (not reaching the apex), two circular enclosing lines near anterior margin of pronotum, and a large median rounded spot near the base of the scutellum, black: angles of the pronotum, castaneous: both pronotum

and scutellum very obsoletely and obscurely punctate; the corium finely but distinctly punctate: angles of pronotum produced in short, robust spines of which the apices are rounded above and subtruncate: body beneath ochraceous, much tessellated with black: the pronotal spines above castaneous (*Dist.*). Long, 10; exp. angl. pron., 10 mill.

Reported from Sadiya (Assam).

Genus CLINOCORIS, Hahn, Stål.

Pt. Wanz. Ins. ii, p. 70 (1834); Stål, Oefvers. K. V.-A. Förh., xxix (3), p. 39 (1872); En. Hem., v, p. 110, 114 (1876). Includes *Sastragala*, Fieber, Eur. Hem. p. 78, 327 (1861);—*Elasmotethus*, pt, Fieber, l. c., p. 78, 328 (1861);—*Elasmucha*, Stål, A. S. E. F. (4 s.) iv, p. 54 (1864); Oefvers. K. V.-A. Förh. p. 638 (1870);—*Meadorus*, Muls. and Rey, Pun. France, Pent., p. 315 (1866).

Antennæ 5-jointed, two-thirds of the length of the body, inserted under the margin of the head forwards in a small elevation, the first joint stout and almost as long as the third; the second as long as the fourth but thinner; the third somewhat shorter than the fourth which however is stouter and almost as stout as the rounded fifth joint: rostrum 4-jointed; ocelli small, placed near the posterior margin of the head: corium besides the strong vein on the inner margin; with a longitudinal vein arising at the base and bifurcated before the middle: membrane with a transverse cellule-like vein emitting six longitudinal veins towards the external margin: feet comparatively long and slender. The mesostethial ridge posteriorly is produced hindwards between the intermediate coxæ: the posterior lateral margins of the pronotum are narrowly depressed and slightly amplified; the furrow from the orifices short, or somewhat so: two apical ventral segments in ♀, without a subimpressed, opaque, lateral spot.

326. CLINOCORIS RECURVUS, Dallas.

Acanthosoma recurvum, Dallas, List Hem., i, p. 310 (1851); Walker, Cat. Het. ii, p. 394 (1867).

Clinocoris recurvus, Stål, En. Hem., v, p. 114 (1876).

♀. Ovate, above pale olive, punctured with black: head thickly and finely punctured with black, the tylus longer than the juga: pronotum thickly and strongly punctured with black; the lateral angles produced into strong, acute, slightly recurved, deep red spines; the disc with a broad, transverse, yellowish white band across the middle: membrane transparent, brownish: margins of the abdomen dull orange, with a black spot at the posterior angle of each segment: body beneath fulvous, punctured with black; the abdomen sparingly and finely, the

pectus more thickly and coarsely punctured: ventral ridge, impunctate, well marked, but not very prominent: legs yellowish testaceous, with the claws black: rostrum testaceous, with the apex black: antennæ testaceous, with the apical half of the fifth joint black (*Dallas*). Long, $10\frac{1}{2}$ mill.

Reported from N. India.

327. *CLINOCORIS PUNCTATUS*, Dallas.

Acanthosoma punctatum, Dallas, List Hem., i, p. 306 (1851); Walker, Cat. Het. ii, p. 393 (1867).

Clinocoris punctatus, Stål, En. Hem., v, p. 114 (1876).

♀. Greenish testaceous, coarsely punctured: head punctured with brown; tylus passing the juga: pronotum strongly and closely rugosely punctate, the punctures brown: scutellum triangular, with the apex much attenuated and produced, strongly but not thickly punctured with brown: corium very coarsely punctured, but with a small impunctate patch on the disc a little behind the middle: membrane transparent, colourless: margins of the abdomen with a small spine at the posterior angles of each segment, and with a small black spot on each segment at the posterior margin: abdomen beneath coarsely and sparingly punctured on the sides, the disc impunctate and with a very distinct median longitudinal ridge: pectus thickly and strongly punctured, especially on the sides: legs orange-testaceous: antennæ testaceous, with the two apical joints brown (*Dallas*). Long, $9-9\frac{1}{2}$ mill.

Reported from N. India.

328. *CLINOCORIS CRUCIGER*, Reuter.

Clinocoris cruciger, Reuter, Berlin. Ent. Zeitschr., xxv, p. 80 (1881).

♀. Saturated ochraceous, head with some fine punctures, pronotum, scutellum and hemelytra strongly impressly-punctured: third joint of the antennæ subequal in length to the second, two last equally long, last black, base pallid: anterior lateral margins of the pronotum, with an arch just behind the apical margin, a longitudinal line and another transverse line just behind the middle forming a cross with the former, and lateral angles, impunctate, levigate; these lateral angles straightly, spinosely produced outward, with a distinct spine slightly recurved, not quite acuto; membrane hyaline, with a band irregularly streaked fuscous: abdomen above unicolorously ochraceous, beneath with two discoidal bands and a lateral row of spots on both sides, pale yellowish. Rostrum not extending beyond the last coxæ: the part of

the posterior margin of the pronotum between the margin of the corium and angle, equal in length to the remaining part, towards the base much, and towards the angle slightly sinuated, the latter part within the margin of the corium straight, very slightly oblique, whence the basal margin slightly and very broadly sinuate, basal angles very obtuse: scutellum with almost two rows of dots towards the apex which is not quite acute: exterior margin of corium, behind the middle, strongly roundly amplified towards the apex: pectus sparingly, prostethium strongly, punctured fuscous; mesosternal plate much higher towards the apex than before the intermediate coxæ, apex almost extending beyond the prosternum, and apical margin obliquely truncate, inferior margin slightly rounded towards the apex and towards the intermediate coxæ gradually broadly but strongly sinuate: ventral spine reaching the apex of the mesosternal plate: sixth ventral segment, in ♀, emarginate at the apex: apical margin truncate in the middle, folded at the angles of the emargination; superior genital lobes short, very slightly rounded at the apex, contiguous to entire interior margin (*Reuter*). Long, $6\frac{1}{2}$; with membrane, 8 mill.

Reported from Darjiling.

329. CLINOCORIS SCUTELLATA, Distant.

Clinocoris scutellata, Dist., Trans. Ent. Soc., p. 355 (1887).

Body above ochraceous, thickly and coarsely punctate: spines of pronotum rosy red: scutellum with a blackish median longitudinal band extending from about the base to the middle: antennæ ochraceous: lateral angles of the pronotum straightly produced into subacute spines of which the apices are slightly reflexed hindwards, and the posterior margins are somewhat sinuated: membrane pale hyaline, with reflections of the red upper surface of the abdomen: body beneath and legs ochraceous: sternum coarsely punctuate (*Dist.*). Long, 8; exp. angl. pron., 6 mill.

Reported from Naga Hills (Assam).

330. CLINOCORIS MACULATA, Distant.

Clinocoris maculata, Dist., Trans. Ent. Soc., 355 (1887).

Body above black ochraceous: pronotum and scutellum coarsely but sparingly punctate, corium thickly punctate: spines of pronotum black: corium with a levigate, ochraceous spot on the disc of the apical area: punctuation entirely dark-brownish and the corium is therefore much darker than the pronotum or scutellum: lateral angles of pronotum produced into stout spines of which the apices are subacute

and prominently reflexed, and their posterior margins sinuated: membrane very pale ochraceous, pitchy towards the apex: body beneath apparently ochraceous (*Dist.*). Long, 8; exp. angl. pron. 6 mill.

Reported from N. E. India,

Subfamily UROSTYLINA, Dallas.

Urostylidæ, Dallas, Trans. Ent. Soc., n. s. ii, p. 15, (1852); List Hem., i, p. 313 (1851);—*Urolabidina*, Stål, En. Hem., v, p. 115 (1876).

Antennæ 5-jointed, basal joint extending to a distance beyond the head: rostrum short, scarcely passing the anterior coxæ, basal joint enclosed in a groove: head small, tylus as long as the juga, lateral margins not trenchant; antenniferous tubercles exserted: genitalia generally more or less produced: odoriferous orifices spinose: pectus not sulcated (*Dallas*).

I. Ocelli present.

a. Basal joint of the antennæ nearly as long as the head and the pronotum taken together; antennæ very slender:—2. *Urostylis*.

b. Basal joint of the antennæ not twice the length of the head, much shorter than the head and pronotum; antennæ stouter:—1. *Urochela*.

II. Ocelli wanting:—3. *Urolabida*.

Genus UROCHELA, Dallas.

Trans. Ent. Soc., n. s., i, p. 2 (1850); List Hem., i, p. 313 (1851); Walker, Cat. Het. ii, p. 410 (1867); Stål, En. Hem. v, p. 115 (1876).

Head small, short, broader than long, abruptly narrowed, just before the eyes; juga and tylus produced, distinct, rounded; tylus longer than the juga; eyes large, prominent, globose; ocelli moderate, situate close to each other at the back of the head; antennæ longer than the body, 5-jointed, inserted in a tubercle which appears beyond the margin of the head, just before the eyes; first joint stoutest, as long as the pronotum, cylindrical, thinner at the base; second about half as long again as the first, and a little stouter than the second; fourth about as long as the first, slender; all clothed with fine short hairs which are longer on the first joint: rostrum inserted close to the anterior margin of the head, short, reaching only to the middle of the mesostethium, 4-jointed, 1 and 3 joints nearly equal, fourth shorter, second longest; the first at its base enclosed in a small groove of the underside of the head; labrum reaching the middle of the second joint of the rostrum, transversely striated. Body broad, very flat above, convex beneath: pronotum trapezoidal, slightly margined laterally, much narrowed in front, the anterior

margin being considerably narrower than the head and eyes: scutellum rather short, triangular, with the sides nearly straight and the apex acute. Hemelytra ample, the coriaceous part larger than the membranous, with the basal half of its outer margin much elevated; a vein which arises from a strongly elevated line at the base, runs about two-thirds the length of the corium, where it emits a branch on its inner side which reaches the base of the membrane, and passing into it, gives rise, after running singly for a short distance, to five veins on the disc of the membrane, of which the two inner and the two outer ones are united at the base before joining the common trunk: the membrane reaches beyond the apex of the abdomen, and has six veins, of which the outer one is very short, placed at the basal angle. Abdomen convex beneath, the margins thin, projecting a little beyond the hemelytra on each side: the anal apparatus, in ♂, consists of two claw-like processes which project nearly as far as the posterior angles of the terminal segment of the abdomen, with their points turned outwards; a small triangular plate is situate at the base of these which it partially covers, and within the cavity appears the apex of a second triangular piece, which is probably the margin of the dorsal portion of the segment; all these parts are clothed with long woolly hairs, which nearly fill the intermediate spaces: in the ♀, the vulvar plates are not remarkable: the pectus is flat; mesostethium broad, placing a considerable interval between the insertions of the anterior and the intermediate feet; on each side of the metastethium close to its anterior margin and near the intermediate coxæ is a small spino directed outwards and forwards, these appear to be perforated on their posterior surface, at about half their length and are evidently formed by the produced margins of the odoriferous apertures: legs moderate, slender, the posterior pair longest; tarsi 3-jointed, 1 and 3 about equal, the second minute (*Dallas*). Distinguished from *Urostylis*, Westw., by its stout antennæ of which the first joint is not much longer than the head.

331. UROCHELA QUADRIPUNCTATA, Dallas.

Urochela 4-punctata, Dallas, Trans. Ent. Soc. (n. s.) i, p. 3, t. 2, f. 1 (1850): Walker, Cat. Het., ii, p. 410 (1867); Stål, En. Hem. v, p. 115 (1876).

Body elongate-ovate, above ferruginous grey, finely and thickly punctured: pronotum narrowly margined with yellow and with a narrow, impunctate, longitudinal line on the disc, of the same colour; a small black spot on the lateral margin, near the lateral angle: scutellum with a narrow longitudinal yellow line, continuous with that of the pronotum, the lateral margins yellowish: the basal third of the outer margin of the hemelytra and a small line in the yellow basal portion, a spot on the

disc, and another at the middle of the apical margin, black; membrane pale brown, with the veins paler. Connexivum banded with yellow and black; abdomen beneath smooth, impunctate, yellow; a spot on each side of each segment within the stigmata, and another on the lateral margin, black; head beneath, pectus and rostrum, testaceous; the apex of the latter, pitchy: legs dusky testaceous, femora punctured with pale brown: antennæ with the basal joint dusky testaceous, second black, pale at the base, 3-4 joints black, basal portion of the latter, yellowish white (*Dallas*). Long, 9 mill. Type.

Reported from Bhutan, Sikkim; very common on Observatory Hill, Darjiling, at the end of the rains (mibi), and at Mungphu.

332. UROCHELA GUTTULATA, Stål.

Urochela guttulata, Stål, En. Hem., v, p. 115 (1876).

♀. Paley grey-flavescent, above more densely and more distinctly, beneath more remotely and more finely, punctured fuscous; antennæ blackish; first joint altogether or only towards the base, 4-5 joints towards the base, greyish-flavescent: a line on the pronotum and scutellum, more or less distinct, levigate, anterior scars inwardly blackish: hemelytra with a small fuscous spot on the disc and at the middle of the apical margin, sometimes absent: membrane fuscous with small rounded pallid spots, here and there confluent; lateral streak on the pectus and lateral spots arranged in longitudinal rows, black (*Stål*). Long, 12; broad, 5½ mill.

Like *U. quadripunctata*, Dallas, but larger, antennæ shorter and more slender, lateral margins of pronotum dilated, before the middle obtusely roundly-amplified and obsoletely sub-serrate, slightly sinuated in the middle, the levigate line on the pronotum and scutellum much less distinct, sometimes partly evanescent; membrane sprinkled with pallid dots; pectus very distinctly streaked with black.

Reported from Darjiling, Mungphu (mibi).

333. UROCHELA PILOSA, Stål.

Urochela pilosa, Stål, En. Hem., v, p. 116 (1876).

♂. Paley greyish-flavescent, pilose: pronotum, scutellum, hemelytra and prostethium somewhat strongly punctured black, the former further adorned with fine subferruginous dots: 2-5 joints of antennæ black; 4-5 joints flavescent at the base: lateral limbus of pronotum and hemelytra also dorsum of abdomen, weakly ferruginous: membrane fuscous-vinaceous: two spots on the hemelytra, a band on the segments of the connexivum, and the circuit of the spiracula, black:

sides of venter, punctulate. The ♂ has the genital segment retuse; sides emitting a process turning upwards, acuminate at the tip, somewhat longer than broad at the base. Long, $10\frac{1}{2}$; broad, $4\frac{1}{2}$ mill.

Distinguished from the preceding by being somewhat broader, dorsal punctuation stronger, without the ventral spots arranged in rows or the levigate line on the pronotum and scutellum: lateral margins of pronotum anteriorly obtusely rounded, prominent, not sinuated in the middle, (Stål).

Reported from Darjiling.

334. UROCHELA BIMACULATA, Dallas.

Urochela bimaculata, Dallas, List Hem., i, p. 313 (1851); Walker, Cat., Het., ii, p. 410 (1867); Stål En. Hem., v, p. 116 (1876).

♀. Head, pronotum and scutellum brownish grey, thickly and finely punctured with black: head with two black streaks on the vertex: pronotum with the lateral margins considerably waved: corium whitish, finely punctured with brown and with numerous scattered coarse black punctures; the middle of the disc with a large brown spot, membrane semitransparent, brownish: margins of the abdomen dark brown, with a yellow line on each of the sutures: body beneath fulvous: abdomen with the disc shining, faintly wrinkled transversely and rather sparingly punctured with black; the sides somewhat opaque, thickly and finely punctured with black; the stigmata and two rows of spots on each side of the abdomen black: pectus rather thickly and finely punctured on the sides, with the sternum nearly impunctate: femora testaceous, very thickly covered with fine black or brown points; tibiæ brownish at the apex; tarsi with the apical joint brown: rostrum testaceous, with the tip pitchy: antennæ with the basal joint greyish-testaceous, thickly covered with very minute black points; 2—3 joints black; 4—5 black, with the base yellow (Dallas). Long, 13—14 mill.

Reported from N. India.

335. UROCHELA OBSCURA, Dallas.

Urochela obscura, Dallas, List Hem., i, p. 314 (1851); Walker, Cat. Het., ii, p. 410 (1867); Stål, En. Hem., v, p. 116 (1876).

♂. ♀. Above brown, somewhat obscure, densely and finely punctured; head impunctate, black, with a spot on each side within the eyes, a spot on the middle of the vertex, and the apices of the juga, brown: lateral margins of the pronotum waved, narrowly edged with yellow: scutellum rather coarsely punctured with black, with the basal angles yellowish;

the apex with an indistinct reddish longitudinal ridge: hemelytra clouded with blackish; membrane brown, opaque: margins of the abdomen black, with a yellow line on each of the sutures: body beneath roddish: abdomen impunctate, minutely transversely rugose, with the stigmata black: pectus finely punctured with black on the sides; pectus impunctate, black: legs brownish; femora with brown dots: rostrum brownish testaceous, with the tips pitchy; antennæ with the basal joint pitchy brown, paler at the base; 2—4 joints, black; fifth joint orange, tip black: anal plate, in ♂, is entire, convex, and encloses a second plate, within and above which the sexual organs are visible (*Dallas*). Long, $10\frac{1}{2}$ —12 mill.

Reported from India.

336. UROCHELA DISCREPANS, Walker.

Urochela discrepans, Walker, Cat. Het., ii, p. 411 (1867).

Tawny, elongate-elliptical, thinly punctured, a little paler beneath; punctures brown or black: head with a black spot on the hind border; tylus conical, extending much beyond the juga; rostrum extending nearly to the hind border of the third ventral segment; tip black: antennæ black, more than half the length of the body; first joint extending much beyond the front of the head; second as long as the first; third about half the length of the second; fourth a little shorter than the second; fifth reddish, piceous towards the tip, a little shorter than the fourth: pronotum with four incomplete and irregular black stripes and with black, slightly reflexed sides: scutellum with two broad black stripes, and with a black dot on each fore angle: pectus and under side of abdomen with four rows of black points: hemelytra with two black dots, one on the disc and one on the middle of the outer border: membrane lurid cinereous. Distinguished from *U. bimaculata* by the tylus being more prominent, and the first joint of the antennæ being more slender (*Walker*). Long, $12\frac{1}{2}$ —13 mill.

Reported from India.

337. UROCHELA PULCHRA, Distant.

Urochela pulchra, Dist., Trans. Ent. Soc., p. 356, t. 12, f. 8 (1887).

Body above ochraceous, shaded, and punctured brownish: head and pronotum brownish, margins of pronotum, olivaceous; antennæ brownish, second joint longer than the first: scutellum olivaceous, with scattered, coarse, brown punctures, with some mottled markings and a spot in each basal angle of the same colour: corium olivaceous, with large, irregular, coarse, brown punctures on inner area; clavus brown-

ish; membrane brownish, apex paler: body beneath brownish, laterally spotted ochraceous; connexivum ochraceous, spotted black: legs ochraceous, femora speckled brownish: apex of rostrum pitchy (*Dist.*). Long, 15 mill.

Reported from Sikkim (Rangbi, mihi).

338. *UROCHELA FERRUGINEA*, Distant.

Urochela ferruginea, *Dist.*, *Trans. Ent. Soc.*, p. 356 (1887).

Body above brownish ochraceous, very thickly and darkly punctate: eyes and two median lines on head, fuscous: antennæ fuscous, 1-2 joints subequal in length, third very short: pronotum with a median longitudinal line and the margins, narrowly luteous: scutellum with a median longitudinal line, a linear spot at the basal angles, the apex and the margin, narrowly luteous: corium with the margins narrowly, and some longitudinal discal lines luteous: membrane fuscous: connexivum fuscous, with lineate ochraceous spots: body beneath brownish ochraceous, tinged with fuscous, and with fuscous lateral spots, connexivum as above: legs brownish ochraceous, apices of the tibiæ and the tarsi fuscous (*Dist.*). Long, 12 mill.

Reported from Assam.

Genus *UROSTYLIS*, Westwood.

Pt. Hope, *Cat. Hem.*, i, p. 45 (1837); *Dallas*, *List Hem.*, i, p. 313 (1851); *Stål*, *En. Hem.*, v, p. 117 (1876).

Antennæ very long and slender, basal joint nearly as long as the head and pronotum taken together: rostrum and pronotum as in *Urolabida*, *Westw.*: body less elongated: ocelli present: membrane with seven longitudinal veins: abdomen, in ♂, simple, not armed with a forceps; in ♀, terminated by a true, corneous, curved, recurved stylus, bifid at the apex.

339. *UROSTYLIS PUNCTIGERA*, Westwood.

Urostylis punctigera, *Westwood*, *Hope*, *Cat. Hem.*, i, p. 45 (1837); *Dallas*, *List Hem.*, i, p. 315 (1851); *Walker Cat.*, *Het.*, ii, p. 411 (1867); *Stål*, *En. Hem.*, v, p. 116 (1876); *Distant*, *A. M. N. H.*, (5 s.) iii, p. 45 (1879).

Rufescent-luteous, punctured, above more or less tinted virescent; pronotum with two somewhat large black spots in the middle towards the anterior margin (sometimes absent); hemelytra with a somewhat large black spot in the middle of the corium: antennæ fuscous, base of the fourth joint, luteous: body beneath and feet concolorous (*Westw.*). Body long, 10½ mill.

Reported from Bengal, Nepál, common in Sikkim (mihi), Calcutta.

340. *UROSTYLIS GRACILIS*, Dallas.

Urostylis gracilis, Dallas, List Hem., i, p. 315 (1851); Walker, Cat. Hem., ii, p. 411 (1867); Stål, En. Hem., v, p. 116 (1876); Distant, A. M. N. H., (5 s.) iii, p. 45 (1879).

♂. Head impunctate, orange: eyes black: pronotum, scutellum and hemelytra green, rather thickly and finely punctured: membrane semitransparent, brownish: body beneath yellow, legs fulvous; tibiae pale; tarsi brownish: rostrum testaceous, with the tip black: antennæ, very long and slender; basal joint orange; second greenish; 3—5 joints brownish, the two latter with the base greenish-white (*Dallas*). Long, $10\frac{1}{2}$ mill.

Reported from N. India, Sikkim (mihi).

341. *UROSTYLIS PALLIDA*, Dallas.

Urostylis pallida, Dallas, List Hem., i, p. 315 (1851); Walker, Cat. Hem., ii, p. 411 (1867); Stål, En. Hem., v, p. 117 (1876).

♀. Above pale greenish yellow: head brownish: pronotum finely punctured with brown, with the lateral margins waved: scutellum more strongly punctured with brown than the thorax: coriaceous portion of the hemelytra thickly and finely punctured, with the inner and outer portions of the apical margin black, the median portion yellow: membrane transparent whitish, with a black spot in the inner basal angle: body beneath orange: abdomen with the disc smooth and shining, the sides reddish and faintly wrinkled: legs testaceous; femora covered with brown points, which, towards the apex, form a short line on each side: rostrum yellow with the tip black: antennæ with the basal joint testaceous; the remainder pale brown (*Dallas*). Long, $13\frac{1}{2}$ —14 mill.

Reported from N. India, Sikkim (mihi).

342. *UROSTYLIS NOTULATA*, Dallas.

Urostylis notulata, Dallas, Trans., Ent. Soc., (n. s.), ii, p. 16 (1852); Stål, En. Hem., v, p. 117 (1876).

♀. Ovate, pale testaceous: head rather small, triangular, broader than long; impunctate, faintly wrinkled, with a small oblique pit on each side within the eyes; the apex of the lobes and the whole underside of the head, pale yellow; eyes dark brown, ocelli reddish; antenniferous tubercles, brown: antennæ clothed with very small whitish hairs; the basal joint testaceous, becoming dusky towards the apex and covered with very minute brown punctures; 2—4 joints brown, the last rather paler; rostrum pale yellow with the extreme tip black: pronotum

broader than long, trapezoidal, with the anterior angles rounded off; pale testaceous, rather thickly punctured with brown, with an abbreviated longitudinal red line on the middle of the anterior portion; the disc with a faint transverse furrow or impression before the middle; the portion between this furrow and the anterior margin elevated; beneath testaceous, finely punctured with brown, and with a pale reddish patch within each antero-lateral angle: scutellum testaceous, rather thickly punctured with brown: meso- and meta-notum beneath, pale fulvous, smooth, impunctate, with a large dull, pale-brown patch on each side. Legs clothed with fine whitish hairs: femora yellow-testaceous, covered with fine brown points; tibiæ and tarsi dusky; claws brown: corium testaceous, thickly and rather finely punctured; the punctures pale brown, the apical margin brown, with the median portion yellow: membrano transparent, colourless, with a dark brown spot on the inner basal angle: wings semitransparent, brownish: abdomen above bright red, shining, very finely wrinkled transversely, with a blackish line on each side within the margins: the margins brownish testaceous, edged with brown: abdomen beneath with the disc pale fulvous, flat, shining, finely wrinkled transversely, covered with very minute brown points; the sides red; the margins testaceous (*Dallus*). Long, $12\frac{1}{2}$ — $13\frac{1}{2}$ mill.

Reported from N. India.

343. *UROSTYLIS FUMIGATA*, Walker.

Urostylis fumigata, Walker, Cat. Het. ii, p. 413 (1867): var., Distant, Scien. Res., 2nd Yarkand Miss., p. 7 (1879).

Testaceous, fusiform, very finely punctured: head very small: rostrum extending to half the space between the first coxæ and the intermediate pair, apex black: antennæ nearly as long as the body, first joint almost as long as the pronotum, second much longer than the first, third piceous, a little more than half the length of the second, 4-5 piceous, pale testaceous towards the base, fourth a little shorter than the second, fifth much shorter than the fourth: pronotum with a very slight transverse impression; sides very slightly reflexed, abdomen with large apical appendages; the upper segment lanceolate, armed beneath with two spines: membrano brownish cinereous (*Walker*). Long, $9\frac{1}{2}$ mill.

Reported from Silhat, Murree (Marri).

• 344. *UROSTYLIS PHILOIDES*, Walker.

Urostylis philoides, Walker, Cat. Het., ii, p. 413 (1867).

Testaceous-green, fusiform, very finely punctured, testaceous beneath:

head small: rostrum extending almost to the intermediate coxæ, apex black: antennæ a little longer than the body; first joint a little longer than the pronotum, second as long as the first; third black, about half the length of the second, fourth blackish, pale testaceous at the base, a little longer than the second: pronotum with a very slight transverse impression, sides hardly reflexed: scutellum ochraceous towards the tip and with an ochraceous callus on each side at the base; abdomen, in the ♂, with very large apical appendages; two long, stout, slightly ascending spines, above which there are two small spines: hemelytra pale green; membrane lurid-cinereous. Distinguished from the preceding by the longer and more slender basal joint of the antennæ and by the protuberances on the scutellum (*Walker*). Long, $7\frac{1}{3}$ mill.

Reported from Burma.

345. *UROSTYLIS LOPOIDES*, Walker.

Urostylis lopoides, Walker, Cat. Het., ii, p. 414 (1867).

Testaceous, elongate-elliptical, minutely punctured; punctures brown: head small: rostrum extending to half the space between the first coxæ and the intermediate pair: antennæ pubescent, as long as the body; first joint rather stout, as long as the pronotum, second black, testaceous at the base, as long as the first; third black, about half the length of the second; fourth black, whitish for nearly half the length from the base; shorter than the second; fifth whitish, black towards the tip, shorter than the fourth: pronotum with a pale testaceous longitudinal line and with a slight transverse impression, pale testaceous and slightly reflexed on each side and along the fore border; an elongated black point in front of each hind angle: scutellum with a pale testaceous line: legs moderately long and slender: hemelytra with four small brown spots, first and second costal; first near the base, second at a little before the middle, third on the disc; fourth on the middle of the outer border; membrane lurid-cinereous (*Walker*). Long, $8\frac{1}{2}$ — $9\frac{1}{2}$ mill.

Reported from India.

346. *UROSTYLIS NIGROMARGINALIS*, Reuter.

Urostylis nigromarginalis, Reuter, Berlin. Ent. Zeitschr., xxv, p. 85 (1881).

♀. Testaceous, above erectly pallid pilose: pronotum, scutellum, and corium externally sparingly punctured with large impressed ferruginous dots; scutellum with a subtriangular, fuscose spot towards the base, a little more densely punctured; corium internally and towards the apex very finely and obsoletely concolorously punctured, impressed at the claval suture with a row of minute dots, clavus also at the

scutellary margin with a row of strongly impressed dots, lateral margin of corium itself thinly black: membrane hyaline-white, interior and basal margins also excurrent streak on apex of membrane, fuscous. Long, $12\frac{1}{4}$ mill.

Rostrum reaching somewhat the middle of the mesosternum: antennæ longer than the body, rufous-testaceous, two first joints with long pallid exserted hairs placed close together, third briefly pilose, last sub-glabrous, first joint subequal in length to pronotum and half the head taken together, second joint almost one-third longer than first and a little over $2\frac{1}{2}$ time longer than third, the third twice shorter than fourth, basal halves of fourth and fifth, pallid; the fifth shorter than the fourth: anterior lateral margins of pronotum ochraceous, finely serrulate, with long pale hairs, slightly reflexed in the middle: prosternum without a median ridge (♀): mesosternum longitudinally obsoletely subsulate at the base, equally convex on the disc: feet pallid-pilose, apices of the tibiæ and tarsi, ferruginous: sixth ventral segment, in ♀, about two-thirds longer than preceding, apical margin very slightly rounded; dorsal genital lobes seen from above triangular, very slightly rounded on the exterior margin, interior broadly distant with margin subsinuated, impressed on the disc, inward in the form of an arch, red; seen from beneath, elongate, with the apex acutely rounded, interior margin carinate, ventral lobes turning upwards (*Reuter*).

Reported from Darjiling.

Genus UROLABIDA, Westwood.

Pt., Hope, Cat. Hem., i, p. 45 (1837); Dallas, List Hem., i, p. 313 (1851); Trans. Ent. Soc. (n. s.) ii, p. 16 (1852); Stål, En. Hem., v, p. 117 (1876). Includes *Urostylis*, p., Westwood, l., c., p. 45 (1837): *Calliprepes*, White, M. N. H., (n. s.) iii, p. 543 (1839); Trans. Ent. Soc. iii, p. 93 (1842):—*Typhlocoris*, Herr. Schaff., Wanz. Ins. v, p. 79 (1839); ix, p. 175 (1850).

Body elongate-ovate, slender, sides parallel, pronotum as broad as the abdomen, posterior angles not prominent: head small, clypeus short: ocelli wanting: rostrum hardly reaching, or extending beyond, the intermediate coxæ: antennæ, in the ♂, very long, slender, longer than the body, 1-2-4-5 joints of equal length, the third joint shorter: antennæ in the ♀ shorter: hemelytra elongate; membrane with twelve very indistinct longitudinal veins: feet elongate, slender: abdomen, in ♂, terminated by two styli bearing a forceps and with a shorter intermediate spine; in the ♀, terminated by a curved, corneous, recurved appendage produced almost to half the length of the abdomen or not produced. Type, *U. tenera*, Westw.

347. UROLABIDA GRAYII, White.

Calliprepes Grayii, White, Mag. N. H., iii, p. 543 (1839); Trans. Ent. Soc., iii, p. 93 (1841—43).

Urolabida Grayii, Dallas, List Hem., i, p. 316 (1851); Trans. Ent. Soc. (n. s.) ii, p. 16 (1851); Walker, Cat. Het., ii, p. 415 (1867); Stål, En. Hem., v, p. 117 (1876).

Virescent-luteous: pronotum with two posterior triangular dorsal spots, and scutellum with two basal spots, red: membrane with an obscure basal line, coriaceous part with a green transverse line at the apex, oblong-elliptical: head small, with a distinct neck, in front slightly trilobed: antennæ placed on the upper side of the head on a slightly projecting lobe, in front of the eyes which are very prominent; first joint not so long as the head and pronotum, ciliated, cylindrical, rather thickest at the tip: a depression between the eyes which narrows and is continued to the back part of the head, the narrowest part being impressed on the sides, no ocelli: rostrum short, not reaching far beyond the first pair of legs, apparently 3-jointed, second joint longer than first and third: pronotum semicircular, not so broad as the hemelytra, somewhat truncated behind, in front emarginate and margined as are also the slightly sinuated distinctly ciliated sides: scutellum as long as head and pronotum together, pointed: hemelytra large, reaching beyond the abdomen; the membrane with seven veins, the two interior veins almost united at the base, the two exterior united at the apex: legs slender, hairy; tarsi 3-jointed, first joint as long as the second and third together, claws furnished with pulvilli: abdomen flat above, slightly convex below, margined (*White*). Distinguished by the genitalia in the ♀ being of the ordinary form and not produced into large forceps-like process. Long, $14\frac{3}{4}$; breadth of pronotum, $5\frac{1}{4}$ mm.

Reported from Nepal.

348. UROLABIDA HISTRIONICA, Westwood.

Urostylis histrionica, Westwood, Hope, Cat. Hem., i, p. 46 (1837); Walker Cat. Het. ii. p. 411 (1867).

Typhlocoris semicircularis, Herr. Schöff., Wanz. Ins., v, p. 79, f. 525 (1839).

Urolabida semicircularis, Walker, l. c. p. 414.

Urolabida histrionica, Stål, En. Hem., v, p. 117 (1876).

Rufescent luteous, punctured; pronotum and hemelytra tinted virescent; pronotum posteriorly with a testaceous semicircle running through the scutellum to its apex, sides of pronotum testaceous; a black spot at the apex of the corium in the middle; antennæ fuscous, varied with fulvous; body beneath concolorous, feet paler (*Westwood*). Body, long, $10\frac{1}{2}$ mill.

Walker (*l. c. supra*) describes this species as *U. semicircularis*, thus:—Ochraceous, fusiform, very finely punctured: head small; rostrum extending nearly to the intermediate coxæ; antennæ blackish, slender, nearly the length of the body, first joint reddish, as long as the pronotum, second a little longer than the first, remainder successively decreasing in length, fifth joint reddish at the base: pronotum with three bright green patches, one in the middle and one on each side of the hind border; sides slightly reflexed: abdomen and posterior legs, ferruginous: fore legs greenish testaceous; tibiæ black and slightly dilated at the tips; tarsi black at the base: hemelytra with two pale green streaks, and with a deeper green costal streak; an irregular black mark along the outer side; membrane slightly ochraceous; wings pellucid. A variety has the antennæ pale green, joints with blackish tips, first entirely blackish; legs pale greenish testaceous. Distinguished from *U. binotata*, chiefly in the length of the antennæ. Long, $10\frac{1}{2}$ mill.

Reported from India, Sikkim (mihi), Calcutta.

349. UROLABIDA TENERA, Westwood.

Urolabida tenera, Westwood, Hope, Cat. Hem., i, p. 45 (1837); Dallas, List Hem., i, p. 316 (1851); Walker, Cat. Het., ii, p. 414 (1867); Stål, En. Hem., v, p. 117 (1876).

Palely luteous, punctured; pronotum and hemelytra, virescent-luteous; pronotum posteriorly fulvescent: body beneath, antennæ and feet pallid (*Westwood*). Long, $14\frac{1}{2}$ —15 mill.

Reported from India.

350. UROLABIDA UNILOBA, Stål.

Urolabida uniloba, Stål, En. Hem., v, p. 117 (1876).

♂. Closely allied to *U. tenera*, Westwood, but smaller, antennæ shorter, less slender, first joint as long as the pronotum, extremity of the base of the second joint, all the third joint and apical part of the two apical joints, black: genital segment without a lateral process, median process much shorter, gradually narrowed, abruptly recurved from the base, depressed, above with a transverse tubercle almost in the middle, apex bilobed (*Stål*). Long, 10; broad, $4\frac{1}{2}$ mill.

Reported from Darjiling.

351. UROLABIDA BINOTATA, Walker.

Urolabida binotata, Walker, Cat. Het., ii, p. 415 (1867).

Greenish, testaceous, fusiform, very finely punctured: head small:

rostrum extending a little beyond the first coxæ, apex black: antennæ slender, a little longer than the body, first joint as long as the pronotum, second as long as the first, 3-5 joints black towards the tips, 3 shorter than 4, the fourth shorter than 3, fifth shorter than 4: pronotum transversely impressed in front; sides slightly reflexed: abdomen with two apical laminæ: hemelytra with a black longitudinal streak extending from the disc to the outer border of the corium: membrane pellucid (*Walker*). Long, $10\frac{1}{2}$ mill.

Reported from Silhat.

352. *UROLABIDA CHENNELLI*, Distant.

Urolabida chennelli, Dist., Trans. Ent. Soc. p. 356 (1887).

Body above reddish ochraceous, marked with black and luteous: head with the median and anterior portions luteous, the eyes fuscous; first joint of antennæ reddish ochraceous; pronotum with a blackish, discal, semicircular line, between which and the base the colour is paler and thickly punctured with fuscous; on the anterior disc are two levigate, luteous spots: scutellum luteous with three black basal spots, one median and one at each angle, a large round, reddish-ochraceous spot divided by a median longitudinal luteous line, and the apical area, distinctly punctured fuscous: corium with the inner claval and the apical margins, black, these black lines outwardly and broadly margined luteous, the costal margin of the same colour: membrane pale hyaline: body beneath and legs luteous, apices of the femora beneath, and apices of the tarsi and rostrum, blackish (*Dist.*). Long, 15 mill.

Reported from Naga Hills (Assam).

353. *UROLABIDA KHASIANA*, Distant.

Urolabida khasiana, Dist., Trans. Ent. Soc. p. 357 (1887).

Above luteous with reddish-ochraceous markings, a small black spot at each lateral pronotal angle, and two black spots on the apical margin of the corium: head with some reddish ochraceous markings behind the eyes which are blackish; 1-2 joints of the antennæ, ochraceous: anterior and lateral margins of the pronotum and transverse bands on disc, also lateral margins of the scutellum and the corium, reddish ochraceous: lateral, claval and apical margins of corium luteous, last with two distinct black spots: membrane pale hyaline: body beneath and legs, luteous: apex of rostrum, a spot on apices of femora beneath, and apices of tarsi, black (*Dist.*). Long, 14 mill.

Reported from N. Khasiya Hills (Assam).

Genus EURHYNCHIOCORIS, Reuter.

Berlin Ent. Zeitschr. xxv, p. 84 (1881).

Body oblong, parallel, somewhat flattish; head horizontal, equal in length to breadth with eyes; juga acuminate, almost twice shorter than clypeus, the latter dilated towards the apex, porrect, genæ subacuminate at the apex, the superior margin more strongly rounded and a very little longer than the juga, bucculæ twice shorter than the head, laminately dilated towards the apex, very low at the base: rostrum long, slender, reaching almost the apex of the fourth ventral segment, first joint extending beyond the bucculæ, second a little less than twice longer than the first, third about one-half shorter than second and as long as the fourth joint: first joint of the antennæ as long as the head, second almost one-third longer than the first, third twice shorter than second, the prosternum obtusely carinate in the middle, and the mesosternum at the base (*Reuter*).

354. EURHYNCHIOCORIS SPARSIPUNCTATUS, Reuter.

Eurhynchiocoris sparsipunctatus, Reuter, Berlin Ent. Zeitschr., xxv, p. 85 (1881).

♂. Ferruginous-fuscous, opaque; pronotum somewhat margined at the base by a transversely impressed line, disc obsoletely rugose, irregularly sparingly sprinkled with rather large, impressed, black dots, here and there, however, irregularly formed into black spots: anterior lateral margin very slightly sinuate in the middle, black, testaceous at the basal angles: scutellum with the basal angles, two patches on the disc, and a spot before the apex, black; towards the base, finely and sparingly, towards the apex, strongly and densely, punctured black: clavus with a row of dots here and there abrupt at the scutellary margin; corium with a row of impressed dots at the claval suture and some large black dots close to this suture and many others situate in the exterior area, disc almost impunctate in the middle, several irregular spots on the exterior margin, median spot on the corium and another at the middle of the apical margin, fuscous: membrane fuscous with 6—7 paler veins: pectus with four black-fuscous marginal dots on each side, first in the middle of the side of the prostethium, second in basal angle of mesostethium, and two last on the metastethium: dorsum of abdomen red, connexivum testaceous, segments broadly banded black in the middle, spiracula on the venter placed amid black dots, sides of segments here with a median point and more internally a small streak on the basal margin, black (*Reuter*). Long, 11 mill.

Reported from Silhat.

Sub-fam. TESSARATOMINA, Stål.

Hem. Afric., i, p. 33, 233 (1864); En. Hem., i, p. 60 (1870):—*Edessidae*, pt., Dallas, List Hem. i, p. 316 (1851).

(a) as in sub-fam. PENTATOMINA (Jour. As. Soc. Ben. pt. II, p. 129, 1887).

(b.) Spiracula of the basal ventral segment not hidden by the posterior part of the metastethium, sides of the basal segment scarcely shorter than those of the second segment.

Stål makes the following sub-divisions of the Asiatic species:—

Tarsi 3-jointed: antennæ 4-jointed, second joint shorter than the two apical taken together: apical margin of corium straight or somewhat rounded: membrane at the base with several areolas emitting longitudinal veins; hamus usually distinct; primary and subtended veins entirely distant: segments of abdomen single.

I. Metasternum much elevated and freely produced forwards: scutellum distinctly produced behind the frena, produced part triangular or spoon-shaped: thorax more or less produced hindwards at base in the middle before the scutellum:—Div. *Tessaratomaria*.

II. Metasternum simple or elevated, never freely produced forwards: scutellum equilateral, narrowly and slightly produced at the apex behind the frena, rounded or truncated at the apex: thorax not produced posteriorly:—Div. *Eusthenaria*.

The other divisions are *Oncomeraria* chiefly from Australia; *Prionostraria* and *Cyclostraria* from Africa.

Div. TESSARATOMARIA.

Genus EMBOLOSTERNA, Stål.

En. Hem. i, p. 66 (1870).

Allied to *Tessaratomia* Serv., differs in having the head more acute, perpendicular; eyes larger, ocelli nearer the eyes: lateral angles of pronotum cornuted, anterior lateral margins not flattened out, and apical part of scutellum broader. Body large, obovate; head perpendicular, small, triangular, narrow at apex, subacute; lateral margins somewhat straight, juga much longer than the short tylus and contiguous before it; bucculæ much elevated; eyes large, transverse; ocelli very close to the eyes: antennæ short, somewhat slender, first joint on a level with the apex of the head, second joint a little longer than the third, and somewhat shorter than the fourth: pronotum much declined before the middle, posteriorly amplified and produced hindwards, lateral angles produced outward in a depressed horn, anterior lateral margins somewhat straight,

obtuse towards the anterior margin, not flattened out, posterior lateral margins sinuate : scutellum somewhat equilateral, apical part behind the frena broad, somewhat equilateral, slightly concave : apical margin of corium straight, rounded towards the exterior apical angle : hamus present : prostethium furrowed, the margins of the furrow somewhat amplified : mesostethium with a rather high ridge, prominulous between the first pair of coxæ : metastethium elevated, produced anteriorly in a process which is gradually compressly narrowed, gradually increasing in height forwards, roundly truncated at the apex, and abbreviated between the first pair of coxæ, very obtusely sinuated at the base : apical angles of the abdominal segments, acute, prominulous : feet short, rather stout : femora bispinose beneath at the apex : tibiæ furrowed above (*Stål*).

355. EMBOLOSTERNA TAURUS, Westwood.

Tessaratomia taurus, Westw., Hope, Cat. Hem., i, p. 27 (1837).

Tessaratomia cornuta, Dallas, List Hem. i, p. 342 (1851) ; Walker, Cat. Het., iii, p. 462 (1868).

Black, very thinly punctured : corium more castaneous : apex of scutellum luteous : sides of pronotum produced on both sides in a very large, obtuse horn : body beneath fuscous-luteous ; feet short ; femora bispinose at the apex (*Westw.*). Long, 26-27 mill.

Above chestnut-brown : pronotum anteriorly thickly rugosely punctured, disc moderately punctured and faintly wrinkled transversely : lateral angles produced into broad, blunt horns, convex above and concave beneath ; posterior margin much produced over the base of the scutellum of which the apex is broad, golden-yellow : membrane brassy black : body beneath tawny, abdomen opaque with the median ridge and the lateral margins shining, faintly wrinkled : pectus thickly clothed with a fine golden pubescence, with the sutures deep dark brown, legs castaneous ; rostrum deep castaneous with the apex black : antennæ pitchy (*T. cornuta*, Dallas). Long, 29½ ; exp. hum. 22 mill.

Reported from Malacca, Ligor, Borneo, China.

Genus TESSARATOMA, St. Farg. & Serv.

Enc. Méth., x, p. 590 (1825) : Am. and Serv., Hist. Nat. Ins. Hém., p. 164 (1843) : Dallas, List Hem., i, p. 340 (1851) : Walker, Cat. Het., iii, p. 459 (1868) : Stål, Hem. Afric., i, p. 229 (1864) ; En. Hem., i, p. 68 (1870).

Head somewhat small, triangular, rounded at the apex, flat ; the juga longer than the tylus, and anteriorly contiguous ; antenniferous tubercles very slightly prominulous, unarmed ; bucculæ rather elevated : ocelli near the eyes : antennæ 4-jointed, short, somewhat stout : rostrum

short, reaching somewhat the middle of the mesosternum, first joint posteriorly extending somewhat beyond the bucculæ: pronotum rather produced posteriorly over the base of the scutellum which is somewhat produced at the apex, hardly covering the interior basal angle of the membrane; frena extended to a distance beyond the middle of the scutellum: the apical margin of the corium rounded towards the exterior apical angle: membrane with several areolas at the base, emitting longitudinal veins: prostethium anteriorly slightly dilated, sinuated behind the eyes, canaliculate in the middle: mesostethium with a robust ridge, furrowed behind the middle: metastethium much elevated, somewhat sinuated posteriorly, produced to a distance anteriorly, the produced part compressly narrowed forwards, extended to the first pair of coxæ, touching the mesosternal ridge: second ventral segment elevated in the middle in an obtuse tubercle, and touching the base of the metastethium: feet robust, femora usually spinose beneath at the apex; tibiæ furrowed above; tarsi 3-jointed (*Stål*).

356. TESSARATOMA NIGRIPES, Dallas.

Tessaratoma nigripes, Dallas, List Hem., i, p. 341 (1851); Walker, Cat. Het., iii, p. 461 (1868); Stål, Ofvers. K. V.-A. Förh., p. 642 (1870); En. Hem., i, p. 67 (1870).

Tessaratoma javanica, var. *nigripes*, Voll., Faun. Ent. Ind. Néerl. p. 26 (1868).

♀. Colour and form of *T. papillosa*, Drury: head with the margins narrowly edged black: lateral margins of pronotum rounded, broadly reflexed: apex of scutellum broad and rounded, hollowed above and black: abdomen above black, somewhat shining, finely wrinkled transversely, margins dark brown; beneath dull red, somewhat opaque, very thickly covered with minute confluent punctures, with the median ridge, the lateral margins and an irregular interrupted band on each side of each segment deep pitchy brown: pectus spotted black: sternal ridge deep chocolate brown: legs, rostrum and antennæ, black (or deep brown), the last long and slender (*Dallas*). Long, 32-33 mill.

Reported from Java, Philippines, Sikkim (mihi).

357. TESSARATOMA MALAYA, Stål.

Tessaratoma malaya, Stål, En. Hem., i, p. 67 (1870); Distant, A. M. N. H. (5 s.), iii, p. 45 (1879).

♀. Ochraceous: antennæ, extreme margin of head, rostrum, at least half of the apical part of the scutellum behind the frena, spots on the pectus at the coxæ, and a large transverse lateral spot, also the feet, black or fuscous-piceous: dorsum of abdomen subsanguineous:

wings fulvescent. Differs from *T. javanica*, Thunb., in its larger size, and especially in having the metastethial process gradually higher forwards, freely prominulous anteriorly, not quiescent on the sternum, flattened lateral part of pronotum much and gradually rounded, entirely somewhat reflexed: anal valvules, in ♀, as in *T. Javanica* (Stål). Long, 35; broad, 19 mill.

Reported from Malacca, Ligor, Assam, Sikkim (mihi).

358. *TESSARATOMA JAVANIÇA*, Thunberg.

Oimeæ javanicus, Thunberg, Nov. Ins. Spec., ii, p. 145 (1783): Gmelin, ed. Syst. Nat., i (4), p. 2158 (1788): Stoll, Punaies, p. 9, t. 1, f. 2, and larva, t. 38, f. 271 (1788).

Tessaratomia javana, Burm., Handb. Ent., ii (i), p. 350 (1835).

Tessaratomia proxima, Westw., Hope, Cat. Hem., i, p. 27 (1837): Walker, Cat. Hef., iii, p. 462 (1868).

Tessaratomia papillosa, Blanchard, Hist. Ins. Hém., p. 142, t. 6, f. 2 (1840).

Tessaratomia angularis, Dohrn, Stettin Ent. Zeit., xxiv, p. 349 (1863): Walker, l. c., iii, p. 462 (1868).

Var. *a*.—*Tessaratomia conspersa*, Stål, Trans. Ent. Soc., (3. s.) i, p. 595 (1863): Ent. Hem., i, p. 67 (1870): Walker, l. c., p. 462 (1868): includes *stictica*, De Haan.

Var. *b*.—*Tessaratomia timorensis*, Vollen., l. c., p. 26, t. 3, f. 4 (1868): Walker, l. c., p. 464 (1868).

Tessaratomia javanica, Am. and Serv., Hist. Nat. Ins. Hém., p. 16 (1843): Dallas, l. c., p. 340 (1851): Voll., Faune Ent. l'Arch. Ind. Néerl., iii, p. 25, t. 3, f. 4b (1868): Walker, l. c., 1, p. 461-2 (1868): Stål, Ent. Hem., i, p. 67 (1870).

Varies in coloration from almost ferruginous to light olive brown. In *T. javanica*, the anal segment, in ♂, is truncate at the apex, and the apical angles are rounded: in *T. papillosa*, the anal segment, in ♂, is sinuate at the apex and the apical angles acute. In the latter, the lateral anal valvules, in the ♀, are more distinctly sinuate at the apex and less obliquely than in the former; the interior apical angle, too, is acute and tooth-shaped. Thunberg describes this species as:—'glabrous, luteous, anus obtuse, antennæ and feet ferruginous.' Stoll describes it:—antennæ 4-jointed, black; eyes prominent, distinct: margins of pronotum produced forwards, body red-brown with a pectoral spine: feet black. When alive entire body beneath covered with a white powdery substance, above of the colour of Russian leather or hazel, anterior margin of the head weakly emarginate between the lobes: eyes and ocelli yellowish or glaucous: antennæ blackish-violet, pilose: lateral margins of pronotum sometimes dilated so far as to form a quadrant: apex of scutellum often brown: beneath, entire body, or some patches on the pectus, sternal and abdominal ridges and the margin of the abdomen of a deep blackish brown, or the entire lower surface of that colour: feet black-brownish or violet (Voll.). The ♀ is smaller, sides of thorax rounded, a little

dilated towards the posterior angles; antennæ and feet fuscous, body beneath and abdomen above more carneous: anus formed of a single quadrate lobe (*T. proxima*, Westw.). Long, 26 mill. The length apparently varies from 25 to 35 mill.

Var. *a*:—*T. conspersa*, Stål, ♂. Testaceous-flavescent, rather densely punctured, above remotely and minutely sprinkled fuscous: pronotum rugosely punctured at the anterior lateral margins which are obtusely roundly subangulated in the middle: metasternal ridge somewhat reaching the first coxæ: femora bispinose beneath at the apex (Stål). Long, 25; broad, 14 mill. Celebes, Java, Arakan (mihi). In the Arakanese specimen, the entire scutellum is black. Vollenhoyen makes the apex of the scutellum and the antennæ black; body beneath hardly more obscure: pectus with some transverse brown patches: feet obscure brown-red.

Var. *b*:—*T. timorensis*, Voll.: small; pronotum not dilated, colour hazel, anterior and lateral margins finely rugose: antennæ and feet obscure, almost black. Timor, Sibságar (Assam).

Reported from E. Archipelago, Malacca, Sikkim, Assam (mihi.).

359. TESSARATOMA PAPILLOSA, Drury.

Cimex papillosus, Drury, Ill. Nat. Hist., i, p. 96, t. 43, f. 2 (1770): Wolff, Ic. Cim., i, p. 12, t. 2, f. 12 (1800): China.

Cimex chinensis, Thunb., Nov. Ins. Spec., ii, p. 45, t. 2, f. 59 (1783): Walker, Cat. Hot., iii, p. 461 (1868): China.

Cimex sinensis, Gmelin, ed. Syst. Nat., i (4), p. 2158 (1788): Japan, China.

Tessaratomia chinensis, Guérin, Règne An., Texte, Ins. iii, p. 315 (1829-44): Dallas, List. Hem., i, p. 340 (1851); Walker, l. c., p. 461 (1868): China.

Tessaratomia sonneratii, St. Farg. and Serv., Enc. Méth., x, p. 590 (1825): Guérin, l. c., Icon., t. 55, f. 4 (1833): India.

Larva, *Tessaratomia ossa-cruenta*, Gray, Griffith, An. King., xv, p. 239, t. 46, f. 1 (1832).

Tessaratomia papillosa, Hahn, Wanz. Ins. ii, p. 123, t. 67, f. 204 (1834): Am. and Serv., Hist. Nat. Ins. Hém., p. 16 (1843): Walker, l. c., p. 461 (1868): Stål, En. Hem., i, p. 68 (1870).

Head small, yellowish-olive, eyes of the same colour: antennæ black: pronotum yellow-olive, elevated above the level of the head, sides rather projecting at the ligature of the wings: scutellum triangular, terminating in a point near the middle of the abdomen, upper part of it lying beneath the pronotum: hemelytra opaque, yellow-olive; membrane almost transparent; wings yellow-brown: abdomen above dark red, beneath clay-colour, serrulate on the sides, or with a tooth on each segment: anus terminates in two angular points, with a small spine or cornicle on each side: pectus pale clay colour, having a black

spot directly under the fore-legs and another on each side of the intermediate pair: all the legs brown-yellow; rostrum brown (*Drury*). Long, about 25-26 mill.

Flavescent, anus 4-toothed, sternum porrect (*Gmelin*, l. c.).

♀. Above entirely testaceous: beneath with head and pronotum a little lighter and abdomen a little ferruginous: lateral margins of pronotum almost round, posterior margin truncate, almost straight: sternal process widened, not extending beyond the base of anterior coxæ: abdomen dentate on the sides, last segment with four small angles, the two interior formed by an emargination: all femora beneath with two short spines, placed side by side, a little before the tip (*T. sonneratii*, Serv.). Long, 25-26 mill. Serville observes that he had a specimen of the ♂ in which there was no olivaceous colour, posterior margin of the pronotum yellow, tip of scutellum alone brown: antennæ and feet brown ferruginous. Probably this ♂ belongs to the preceding species. Stål observes that the lateral valvules, in the ♀, are distinctly sinuated at the apex and less obliquely so than in *T. javanica*, the interior apical angle is acute and dentiform.

Reported from China, Java, India. The Indian Museum has specimens from Amoy, Assam, Calcutta.

360. TESSARATOMA (?) FURCIFERA, Walker.

Tessaratomya furcifera, Walker, Cat. Het. iii, p. 463 (1868).

Testaceous: head, pronotum and scutellum thickly and very minutely punctured: head obliquely and finely striated on each side, rostrum piceous; antennæ black, second joint a little longer than the third: thorax with the sides piceous, forming two very much rounded angles, posterior angles rounded: scutellum slightly grooved towards the tip which has a black forked spot: pectus partly black, ridge ferruginous, reaching the fore coxæ: abdomen ferruginous, posterior angles of the apical segment, elongated, acute: legs ferruginous: hemelytra thickly and minutely punctured; membrane pale testaceous-cinereous. Thorax diverging directly from the head less than in *T. papillosa*, sides of thorax almost angular (*Walker*). Long, 27½ mill.

Reported from Siam.

Genus SIPHNUS, Stål.

Trans. Ent. Soc. (3 s.), i, p. 597 (1863); En. Hom., i, p. 68 (1870): Walk., Cat. Het. iii, p. 467 (1868).

Body obovate: head rather large, obtusely triangular: antennæ 4-jointed: pronotum somewhat produced posteriorly, posterior lateral margins slightly sinuate: scutellum triangular, narrow at the apex:

metastethium elevated, produced like a horn forwards: feet short, robust, unarmed. Allied to *Tessaratomia*, head larger, pronotum not so produced posteriorly (*Stål*).

361. SIPHNUS ALCIDES, Stål.

Siphnus alcides, Stål, Trans. Ent. Soc., (3 s.) i, p. 597 (1863); En. Hem., i, p. 68 (1870); Walker, Cat. Het. iii, p. 467 (1868).

♂. Yellow-castaneous, shining, hemelytra more obscure: antennæ obscurely subæneous, apical joint weaker towards the apex: lateral margins of pronotum and abdomen, also costal margin of hemelytra anteriorly greenish-brassy: membrane fuscous: pronotum one-fifth shorter than breadth, sparingly, distinctly punctured, anterior margin somewhat sinuate in the middle, lateral margins slightly rounded behind the middle, not reflexed, posterior margin slightly rounded: scutellum sparingly, distinctly punctured: hemelytra finely, remotely punctured (*Stål*). Long, 31; broad, $16\frac{1}{2}$ mill.

Reported from Cambodia.

362. SIPHNUS HECTOR, Stål.

Siphnus hector, Stål, Trans. Ent. Soc., (3 s.), i, p. 597 (1863); En. Hem., i, p. 68 (1870); Walker, Cat. Het., iii, p. 467 (1868).

♂. Narrowly obovate, weakly castaneous, remotely obscurely punctured: scutellum, antennæ and feet, fuscous-castaneous: apex of two apical joints of the antennæ, apex of scutellum and basal part of femora, yellow-castaneous: hemelytra castaneous, veins sparingly sprinkled flavescent: membrane fuscous: anterior lateral margins of pronotum, margin of abdomen and irregular, transverse spots on venter, arranged in four rows, subæneous-fuscous. Narrower than the preceding, more densely and more distinctly punctured: pronotum one-third shorter than breadth, anterior lateral margins slightly incrassate, straight, anteriorly very slightly rounded, anterior margin slightly somewhat sinuate in the middle, basal margin somewhat straight (*Stål*). Long, 29; broad, 15 mill.

Reported from Malacca.

363. SIPHNUS DILATATUS, Walker.

Siphnus dilatatus, Walker, Cat. Het., iii, p. 467 (1868).

Tawny, elongate-oval: head finely and transversely striated: rostrum extending nearly to the intermediate coxæ; tip black: pronotum and scutellum thinly and roughly punctured: pronotum with a very

slight transverse ridge near the fore-border and with a black marginal line extending on each side from the fore-border, to the hind angle which is rounded and prominent: scutellum darker than the pronotum, triangular, acute, abruptly attenuated and slightly furrowed near its tip: pectus testaceous; sternal ridge lanceolate, extending to the first coxæ, its posterior extremity concave, contiguous to the broad, round, ventral spine, abdomen blackish: beneath piceous, very thickly and finely punctured, its middle part longitudinally and very minutely striated; hind angles of the apical segment elongated, acute, not extending so far as the appendages, which are acute: legs piceous; femora tawny at the base: hemelytra piceous, thickly and minutely punctured: wings black (*Walker*). Long, $38\frac{1}{2}$ mill.

Reported from Siam.

Genus HYPENCHA, Am. and Serv.

Hist. Nat. Ins. Hém., p. 160 (1843): Stål, En. Hem., i, p. 68 (1870).

Head rather pointed: antennæ a little longer than in the genus *Tessaratoma*, with the joints proportionately more slender and not short, stout and incrassate: rostrum not reaching the insertion of the intermediate feet: pronotum transverse, the posterior angles prominent, though rather rounded; the posterior margin slightly rounded and sinuated, not extending over the base of the scutellum: sternal ridge extended in a point which becomes lower at the insertion of the intermediate feet and advances in the form of a recurved hook, compressed and obtuse, beyond the first pair of feet: scutellum not reaching the middle of the abdomen, its tip canaliculate or spoon-shaped: abdomen oval, not or only very slightly enlarged on each side: feet as in *Tessaratomia* but the internal or posterior spine at the end of the intermediate and last femora is notably more robust than the external or anterior spine: there are apparently no spines at the tip of the first femora: the other characters as in *Tessaratomia* (*Am. and Serv.*).

364. HYPENCHA LUCTUOSA, Stål.

Hypencha luctuosa, Stål, Trans. Ent. Soc., (3 s.) i, p. 596 (1863); Stål, En. Hem., i, p. 69 (1870).

Tessaratomia luctuosa, Walker, Cat. Het., iii, p. 463 (1868).

♂. Obovate, subæneous black; above sparingly, distinctly, on hemelytra more finely, punctulate; beneath, densely and finely rugulose punctured: apical joint of antennæ (except the base), head beneath and meso- and meta-stethium yellow-testaceous: lateral angles of pronotum hardly prominent. Allied to *H. apicalis*, St Farg, but

narrower, lateral angles of pronotum rounded, hardly prominent outwards and in no sense forwards: margins of abdomen immaculate: last femora beneath near the apex armed with two spines (*Stål*). Long, 28; broad, 15 mill.

Reported from Burma.

365. *HYPENCHA APICALIS*, St. Fargeau & Serville.

Tessaratomia apicalis, St. Farg. and Serv., Enc. Méth. x, p. 591: Burm., Handb. Ent., ii (i), p. 351 (1835): Voll., Faune Ent. l'Arch. Ind. Néerl., iii, p. 26 (1868); Walker, Cat. Het., iii, p. 462 (1868).

Var.—*Hypencha reriki*, Ellenr., Nat. Tijdschr. Ned. Ind., xxxiv, p. 160, f. 30 (1862); Walker, l. c., p. 462 (1868).

Tessaratomia picea, Dallas, List Hem., i, p. 341 (1851).

Hypencha apicalis, Am. & Serv., Hist. Nat. Ins. Hém., p. 166 (1843); Stål, En. Hem., i, p. 68 (1870).

♀. Deep pitchy brown, shining: last joint of antennæ ferruginous, black at the base: membrane bronzed: sides of pronotum dilated, rounded, its posterior margin very little advanced over the scutellum, of which the apex is spatulate: sternal ridge elongate, rising at its anterior part and extending beyond the base of the first pair of coxæ: abdomen a little denticulate on the margin, by reason of the posterior angles of the upper segments extending beyond those which follow: last segment with four, almost spinose, angles, the two interior formed by one emargination: all the femora with two spines beneath placed side by side a little before the apex, those of the first pair very short those of the last pair long, like the posterior spine of the middle pair (*Serv.*). Long, 33-34 mill.

Var. ♀. Shining-black or piceous, with very numerous, small, brassy-green impressed punctures on the pronotum and scutellum: hemelytra violaceous black, varied with purple and cærulean: anterior angle of the pronotum unidentate: abdomen attenuated hindwards, with the margin serrated, posterior teeth longer, curved and arcuate: the posterior angle of the scutellum fuscous-brunneous, with a foveola, containing an intumescence: antennæ black, apex of the last joint ochraceous-brunneous: feet piceous: beneath fuscous-black; sternum, neck and face ochraceous (*H. reriki*, Ellenr.). Long, 28—29 mill.

Reported from Java, Sumatra, Borneo.

366. *HYPENCHA OPHTHALMICA*, Stål.

Hypencha ophthalmica, Stål, Trans. Ent. Soc., (3 s.) i, p. 596 (1863); En. Hem. i, p. 69 (1870).

Tessaratomia ophthalmica, Walker, Cat. Het., iii, p. 463 (1868).

♀. Distinctly punctured, obscurely ferruginous, tinted subcupreous;

beneath with feet, apex of scutellum and marginal spots on abdomen, sordid testaceous-flavescent: tibiæ above margined black: eyes large: lateral angles of pronotum somewhat prominent, anterior lateral margins somewhat straight: last femora beneath with two spines at the apex (*Stdl.*). Long, 24; broad, 12 mill.

Reported from Ligor, Malacca.

Genus PYGOPLATYS, Dallas.

List Hem., i, p. 338 (1851): Walker, Cat. Het., i, p. 459 (1868); Stål, En. Hem., i, p. 69 (1870).

Head not broader than long, somewhat pointed in front, scarcely emarginate with the lateral margins plane: antennæ 4-jointed, rather stout, basal joint not reaching the apex of the head, second joint longer than the third, fourth about equal to the second: rostrum 4-jointed, reaching the middle of the space between the anterior and intermediate coxæ, second joint longest; basal joint very thick, about as long as the fourth, fourth longer than the third: pronotum with the lateral angles produced into broad flat processes, or strong, pointed spines; the posterior margin produced in a semicircle over the base of the scutellum: pectus with a very strong ridge, attached to the metastethium, where it is somewhat pentagonal, deeply emarginate posteriorly for the reception of the ventral spine, produced anteriorly in a long free spine, reaching far forwards and considerably depressed at its apex; mesostethium with a distinct canal in which the apex of the rostrum reposes: scutellum somewhat obtuse at the apex, distinctly channelled: abdomen oblong, nearly as broad at the apex as at the base, projecting far beyond the hemelytra on each side, with the posterior angles of the apical segment produced; vulvar plates very broad; basal plates received in a semicircular emargination in the middle of the apical segment of the abdomen; lateral plates transverse, with their apices acute and with a strong tooth in the middle of their posterior margins; median plates united, forming a single, somewhat quadrate piece, widened behind, with two strong spines on its posterior margin and its lateral angles rather acute; there are thus eight teeth in the space between the posterior angles of the abdomen: legs moderate; femora unarmed; tarsi 3-jointed (*Dallas*).

367. PYGOPLATYS ACUTUS, Dallas.

Pygoplatys acutus, Dallas, List Hem., i, p. 340 (1851); Walker, Cat. Het., iii, p. 460 (1868); Stål, En. Hem., i, p. 69 (1870).

Pygoplatys roseus, Voll., Faun. Ent. l'Arch. Ind. Néer., iii, p. 24, note, (1868).

♀. Above pale brown, thickly and rather strongly punctured: pro-

notum with a long, stout, acute spine on each side: margins of abdomen with a brassy-green spot on each segment: body beneath and legs somewhat fulvous; sternal ridge bright fulvous; antennæ pitchy brown (*Dallas*). Long, $17\frac{3}{4}$; breadth of shoulders, $16\frac{1}{2}$ mill.

Above rosy, except the base of the head and the anterior inclined part of the pronotum which like the body beneath are luteous: posterior part of pronotum punctured black; lateral horns rather long, turning a little forwards, rounded at the apex, (*P. roseus*, Voll.). Long, 18 mill.

Reported from Malacca, Burma.

368. PYGOPLATYS MINAX, Vollenhoven.

Pygoplatys minax, Voll, Faune Ent. l'Arch. Ind. Néerl., iii, p. 23, t. 3, f. 3 (1868).

♀. Above obscurely fulvous, beneath, luteous-ochraceous: head reddish ochraceous; eyes glaucous, ocelli yellow placed on small, black, cuneiform spots: antennæ of a deeper red, pronotum very broad; lateral angles in the form of horns, rather broad at the base, recurved, diminishing in size towards the tip which is obliquely truncated, their colour is of a deeper red than the disc, marked with small black impressed punctures, the rest of the pronotum is indistinctly punctured, except the transverse part near the anterior margin, posterior margin yellowish: scutellum lightly sprinkled with impressed dots, apex channelled: corium very finely punctured, disc paler; membrane hyaline, colourless: the portion of the abdomen extending beyond the hemelytra is broad, slightly purplish red; the angles of the segments are denticulate and touch almost a submarginal black band: feet and tibiæ with a reddish tinge (*Voll.*). Long, 19 mill.

Reported from Borneo: Indian Museum has a specimen from Johore. Possibly *P. ralandi*, Voll. (l. c.), is only a variety.

Genus AMISSUS, Stål.

Trans. Ent. Soc., (3 s.) i, p. 595 (1863): En. Hem. i, p. 70 (1870).

Body, large, oval: head subelongate; juga very long, contiguous before the tylus; bucculæ much elevated: ocelli remote from the eyes: antennæ 4-jointed: posterior margin of pronotum roundly produced in the middle above the base of the scutellum, which is itself produced at the apex: apical margin of corium straight, apical angle rounded; membrane furnished at the base with many areolæ, emitting longitudinal veins: mesostethium elevated, anteriorly somewhat produced and cleft: metastethium slightly elevated, posteriorly very broadly sinuate: second ventral segment slightly elevated and produced at the base in the

middle: feet somewhat short, femora armed with two spines beneath at the apex: last pair of tibiae about equal in length to the femora: 1-2 joints of tarsi equally long: allied to *Hypencha*, Am. & Serv. but structure of head and of sterna different (Stål).

369. AMISSUS ATLAS, Stål.

Amissus atlas, Stål, Trans. Ent. Soc., (3 s.) i, p. 596 (1863); Walker, Cat. Het., iii, p. 466 (1868); Stål, En. Hem., i, p. 70 (1870).

♀. Fuscous-castaneous: narrow limbus and posterior part of pronotum, apex of scutellum, hemelytra, coxæ, trochanters and margin of abdomen, weakly castaneous: antennæ, veins of hemelytra and the tarsi sub-castaneous-yellow: apical angles of abdominal segments, black: pronotum robustly cornuted: head with the sides subparallel, and slightly sinuate in the middle, subtruncate at the apex, more than twice longer than the breadth: second joint of antennæ somewhat longer than the third, but shorter than the apical: pronotum remotely distinctly punctured, posteriorly somewhat smoother, lateral angles obliquely produced forwards in long, depressed, slightly arcuate horns; anterior lateral margins crenulated: scutellum remotely, distinctly, punctured, smooth at the apex: hemelytra densely punctured, veins smooth: beneath densely alutaceous (Stål). Long, 41; broad, 19 mill.

Reported from Singapore, Tenasserim.

Div. EUSTHENARIA (p. 52).

Genus EUSTHENES, Laporte.

Ess. Hém. p. 64 (1832); Am. & Serv., Hist. Nat. Ins. Hém., p. 167 (1848); Dallas, List Hem., i, p. 342 (1850); Walker, Cat. Het., iii, p. 467 (1868); Stål, Hem. Afric., i, p. 225 (1864); En. Hem., i, p. 71, 230 (1870).

Head almost squarely truncate at the tip: antennæ rather long: pronotum transverse, lateral margins defined, posterior angles prominent but rounded, posterior margin not extending itself over the scutellum: sternal ridge not prolonged beyond the intermediate pair of feet and consisting only of a kind of plate placed between those and the last pair, straightly truncate posteriorly, and rounded anteriorly, narrower in the ♂: scutellum not reaching the middle of the abdomen, its tip ending in a small, almost square and spoon-shaped, prolongation: four vulvar pieces in ♀, square at their tip; anal plate, in ♂, not near so broad as in *Tessarotoma*: feet very robust, first pair rather small, intermediate longer; posterior femora much longer and stouter than the intermediate, especially in the ♂, with a strong hook-like spine at the base; all the femora with two weak spines towards their tips, those of the first pair hard-

ly visible: posterior tibiæ, in ♂, strong, curved inside at their base; tarsi strong and large, second joint almost as large as the third (*Am. & Serv.*).

a. First pair of femora beneath near the apex unarmed or furnished on both sides with a small spinule: intermediate femora beneath, near the apex, with a moderate or small distinct spine: mesostethial ridge or wrinkle depressed, often broadly and distinctly furrowed, posteriorly broader, convex and more elevated: metastethium anteriorly narrowed, not however compressed, touching the elevated base of the mesostethial ridge, posteriorly not or but very slightly inflexed: second ventral segment more or less elevated in the middle, usually touching the base of the metastethium.

b. Feet obscurely piceous or piceous-black: wings usually obscurely fuscous and slightly tinged violaceous.

c. Tarsi and feet concolorous; spiracula cinctured flavescent. *E. robustus*, St. Farg., and *E. scutellaris*, Herr. Schöff.

cc. Tarsi pale castaneous or yellow-castaneous; wings somewhat violaceous-fuscous.

E. hercules, Stål; *E. cupreus*, Westwood, *E. eurytus*, Dist.

bb. Feet, a great part of the first joint of the antennæ and the apex of the scutellum, weakly castaneous: last pair of femora sometimes fuscous-castaneous.

E. polyphemus, Stål.

aa. Fourth joint of the antennæ, yellow-testaceous at the base: wings and dorsum of the abdomen black-violaceous: first pair of femora beneath near the apex, with a somewhat robust spine on the anterior side, with a very minute spinule or unarmed, on the posterior side: middle femora near the apex with a rather large spine on both sides: metastethium anteriorly and posteriorly gradually compressly narrowed: second ventral segment not elevated in the middle, not higher than the first segment: apical angles of the abdominal segments not so prominent as in the preceding.

E. sævus, Stål.

370. EUSTHENES ROBUSTUS, St. Fargeau & Serville.

Tessarotoma robusta, St. Farg. & Serv., Enc. Méth. x, p. 591 (1825).

Oncrmeris robustus, Blanchard, Hist. Ins. p. 142 (1840).

Eusthenes elephas, Dohrn, Stettin Ent. Zeit., xxiv, p. 351 (1863); Walker, Cat. Het., iii, p. 468 (1868).

Eusthenes robustus, Am. & Serv., Hist. Nat. Ins. Hém., p. 167 (1843); Dallas, List Hem., i, p. 342 (1851); Walker, Cat. Het., l. c. p. 468 (1868); Vollenhoven, Faune Ent. l'Arch. Indo-Néer., iii, p. 27 (1868); Stål, En. Hem., i, p. 71, 230 (1870); Distant, A. M. N. H., (5 s.) iii, p. 45 (1879).

♂. Body broad, blackish-brown: antennæ black: pronotum and

scutellum covered with transverse wrinkles which give it a leathery appearance: apex of scutellum and hemelytra brown-ferruginous: sides of pronotum a little dilated, lateral margins dilated, rounded: abdomen dentate on the margins: anus emarginate: all the femora beneath with two spines, side by side, before the apex; posterior femora long, very stout, having a large, strong and very pointed spine towards their base; tibiæ very arcuate, especially at the base (*Serv.*). The anal plate in the ♂ is short and almost straightly truncate at the tip: in the ♀, the anal plate is bilobed, and also the pronotum is more deeply wrinkled, and the ventral grooves are neither so long nor so deep.

Pronotum distinctly broader than the base of the hemelytra, anterior lateral margins somewhat dilated, distinctly rounded behind the middle, lateral angles distinctly prominent, obtuse: apical part of scutellum produced behind the frena, somewhat broadish, subquadrate, obtusely rounded at the apex, flavescent-castaneous: mesostethial wrinkle or ridge posteriorly convexly, elevated: the metastethium not pallescent, at least in ♀, narrowed somewhat forwards before the middle, behind the middle, first narrowed somewhat hindwards, then furnished with parallel sides, truncated at the base, broader at the base than at the apex: second ventral segment elevated in the middle and touching the metastethium: venter marked obliquely behind the spiracula with a small yellow-castaneous spot: last tibiæ in ♂, curved; in ♀, straight, narrowly furrowed beneath from the base, hardly beyond the middle; last tarsi with the first joint at the apex and second at the base yellow-castaneous: wings obscurely subviolaceous-fuscous: dorsum of abdomen opaque (*Stål*). Long, 36-46 mill.

Reported from Java, India, Sibsagar (Assam).

371. *EUSTHENES SCUTELLARIS*, Herrich Schäffer.

Tesseratoma scutellaris, Herr. Schaff, Wanz. Ins. iv, p. 81, t. 133, f. 410 (1839): Walker, Cat. Het., iii, p. 463 (1868).

Eusthenes minor, Voll., Faun. Ent. 1' Arch Indo-Néor., iii, p. 29 (1868).

Eusthenes scutellaris, Stål, En. Hem., i, p. 71, 231 (1870); Distant, A. M. N. H. (5 s.) iii, p. 45 (1879).

Dark castaneous-brown: head, scutellum, abdomen, antennæ and feet darker, apex of the fourth joint of the antennæ ferruginous: above sparingly punctured: pronotum and scutellum transversely rugose; apex of scutellum narrow, produced: last femora incrassate, having near the base inwards, a very long, somewhat curved tooth and before the apex two teeth: last tibiæ stout, arcuate (*Herr. Schaff*), ♂, beneath usually of a very obscure brown with a violet tinge, and the ♀ of a brown-red. Stål remarks that this species differs from *E. robustus*, *Serv.*, in its smaller

size, pronotum not so broad, anterior lateral margins somewhat straight, or very slightly rounded, apex of scutellum narrower, longer, behind the middle, gradually narrowed, angulated at the apex, mesostethial ridge posteriorly broader and more tumid, metastethium pallescent, apparently shorter and broader, abdomen especially behind the middle narrower, posterior angles of sixth segment more acute and produced to a greater distance, anal lobes longer and narrower, last pair of feet a little shorter, last pair of femora not reaching sixth ventral segment, first joint of last tarsi shorter, its apex, also base of second joint concolorous, which, however, varies much: wings paler, palely sub-fuscous ochraceous; dorsum of abdomen subviolaceous-shining. Long, 25-27 mill.

Reported from Java, Sumatra, India, Khasiya Hills (Assam, mihi).

372. *EUSTHENES HERCULES*, Stål.

Eusthenes Hercules, Stål, En. Hem. i, p. 231 (1870).

Above rufescent piceous; beneath piceous-flavescent; a narrow median band on the venter, fuscous, spiracula with a pale cincture; scutellum and feet fuscous-piceous, last pair of feet more obscure; tarsi flavescent-castaneous: dorsum of abdomen obscurely somewhat ferruginous, obsolete punctulate: connexivum subviolaceous-black, basal spot on segments yellow-castaneous: apex of scutellum castaneous.

♂. Anal segment amplified hindwards, broadly somewhat truncated at the apex, somewhat sinuated in the middle, posterior angles rounded at the extremity of the apex: apical angles of the sixth segment of the abdomen not so produced, obtuse at the apex itself: metastethium equally narrowed forwards and hindwards from the middle, equally broad at the base and apex, posteriorly slightly inflexed: second ventral segment not elevated in the middle, not touching the metastethium, punctuation as in the other species of the genus; stature and form of pronotum like *E. robustus*, Serv.; differs in having the pronotum not broader than the hemelytra, the mesostethial ridge posteriorly very slightly elevated and furrowed almost to the base, the colour of metastethium, of the lower side of the body and tarsi; also the first joint of the last pair of tarsi longer: last tibiae in ♂, stout, hardly curved towards the base, beneath narrowly convex, almost third basal part broadly depressed, gradually narrowed (*Stål*). Long, 39; breadth at base of hem. 20 mill.

Reported from Silhat, Naga Hills (Assam).

373. *EUSTHENES EURYTUS*, Distant.

Eusthenes eurytus, Dist., Trans. Ent. Soc., p. 358 (1887).

Allied to *E. hercules*, Stål, but smaller, the pronotum much less rounded at the antero-lateral margins, and the lateral angles even less produced than in that species: antennæ entirely black, except the apical joint which is very narrowly ochraceous at the apex: tarsi bright ochraceous (*Dist.*). Long, 36; exp. angl. pron. 16 mill.

Reported from India.

374. *EUSTHENES CUPREUS*, Westwood.

Tessaratomia cuprea, Westwood, Hope, Cat. Hem., i. p. 27 (1837).

Eusthenes cupreus, Dallas, List Hem., i. p. 342 (1851); Walker, Cat. Het., 1, p. 467 (1868); Stål, En. Hem., 1, p. 71, 231 (1870); Distant, A. M. N. H., (5 s.) iii, p. 45 (1879).

Castaneous, coppery or brassy, more or less shining; scutellum black: antennæ as long as half the body, first joint very minute, 2-3 joints equal, fourth longer, extreme tip rufescent; posterior femora (♂) long and much thickened, furnished with a long spine before the middle and with teeth towards the apex: pronotum and scutellum more or less deeply transversely furrowed: anal apparatus in ♂, formed of two lobes; in ♀, quadrilobate (*Westw.*) Long, 27 mill.

Reported from Nepál, Assam, Sikkim (mihi). N. India, Penang, Siam.

Stål notes (En. Hem. i, p. 231) that in collections two species are confused, one (long, 24; breadth of hem. 12 millims) known by its smaller size, a little more shining, anterior part of pronotum and the hemelytra at base olivaceous, somewhat ænescent, antennæ shorter, anterior lateral margins of the pronotum not reflexed, dorsum of abdomen with a large shining brassy-green disc. The other species is larger (long, 29—35; breadth of hem. $14\frac{1}{2}$ — $17\frac{1}{4}$ millims), less shining, pronotum anteriorly more obscure, but scarcely olivaceous or ænescent, antennæ longer, extreme part of the anterior lateral margins of the pronotum very narrowly reflexed, dorsum of abdomen without a brassy-green disc. The longer of these species is *E. cupreus*, Westw., and the other is *H. theseus*, Stål.

375. *EUSTHENES THESEUS*, Stål.

Eusthenes theseus, Stål, En. Hem., i, p. 231 (1870).

Characters as noted above under *E. cupreus*, Westw.

376. *EUSTHENES POLYPHEMUS*, Stål.

Eusthenes polyphemus, Stål, Trans. Ent. Soc., (3 s.) i, p. 596 (1863); En. Hem., i, p. 72, 232 (1870); Walker, Cat. Het., iii, p. 468 (1868).

♂, ♀. Above more or less obscurely ænescent-castaneous; beneath with feet, apex of scutellum, a great part of the first joint of the antennæ and small dorsal marginal spots on the abdomen, yellow-castaneous: last pair of femora somewhat fuscous-castaneous. In the ♀, the metastethium is posteriorly much broader than in the ♂, in which the form of the metastethium is very like that of *E. hercules*, Stål, and also the form of the second ventral and anal segments, but differs in having the mesostethial ridge more elevated and there without a furrow, the last pair of tibiæ not so stout, and the lower flattened part longer, reaching the middle of the tibiæ. The last tibiæ, in the ♂, are very slightly curved. Differs from *E. robustus*, Serv., in having the anterior lateral margins of the pronotum, not, unless posteriorly, slightly rounded, lateral angles somewhat more prominulous, the very large spine on last pair of femora and the last pair of tibiæ more curved: the last tibiæ, in ♂, are very slightly curved. Long, 33; broad, 17 mill.

Reported from the Dekhan, N. India.

377. *EUSTHENES SÆVUS*, Stål.

Eusthenes sævus, Stål, Trans. Ent. Soc., (3 s.) i, p. 597 (1863); Walker, Cat. Het., iii, p. 468 (1868); Stål, En. Hem., i, p. 72, 232 (1870).

♂, ♀. Olivaceous-black, slightly turning into ferruginous: beneath with the base of the apical joint of the antennæ and the apex of the scutellum, yellow testaceous, here and there purpurascant and ænescent. Smaller than *E. robustus*, Serv., and longer than *E. cupreus*, Westw., differs in having the antennæ a little stouter, also in the colour of the apical joint of the antennæ and of the apex of the scutellum, especially, in having the elevated part of the metastethium narrower posteriorly, and the large spine of the last pair of femora in the ♂ placed nearer to the base; the other spines on the last femora are fewer and smaller than in *E. robustus*: apical angles of sixth abdominal segment, in ♂, somewhat straight, hardly acute: anal segment in ♂ posteriorly: broadly and obtusely sinuated, posterior angles obtusely rounded (Stål.) Long, 27-30; broad, 13 mill.

Reported from N. China: Dekhan, Sikkim (mihi).

378. *EUSTHENES ANTENNATUS*, Distant.

Eusthenes antennatus, Distant, Trans. Ent. Soc., p. 357 (1887).

Head, pronotum and corium purplish brown: legs ochraceous;

scutellum very dark olivaceous with the apex castaneous: membrane shining brassy brown: basal and apical joints of the antennæ ochraceous, the last with the apex blackish, 2—3 joints blackish, base of second joint very narrowly ochraceous: apical joint somewhat longest, 2 very slightly longer than 3: body beneath brownish-ochraceous, or, in some, castaneous: legs castaneous, tarsi very slightly pale: pronotum finely, transversely striate; scutellum more coarsely striate; corium thickly and finely punctate: posterior femora with a long spine and a double row of short spines on apical half of the under surface, of which the two last are the longest. The elongate form of the body and the colour of the antennæ distinguish this species which is variable: connexivum generally purplish brown, with a more or less distinct ochraceous spot at the base of the segments (*Dist.*). Long, 35-36; exp. angl. pron., 12 mill.

Reported from Khasiya Hills (Assam); Nepal.

Genus EUROSUS, Dallas.

List Hem., i, p. 342 (1851); Walker, Cat. Het., iii, p. 468 (1868); Stål, Hem. Afric., i, p. 225 (1864); En. Hem., i, p. 72 (1876).

Head longer than broad, narrowed in front, with the apex slightly emarginate: antennæ 4-jointed, second joint longer than the third, fourth about equal to the second: rostrum 4-jointed, scarcely reaching the middle of the mesostethium, second joint longest, 3-4 nearly equal, shorter than the first; pronotum with the lateral angles unarmed, posterior margin not produced: scutellum, short, not reaching the middle of the abdomen; the apex small and rounded, somewhat spoon-shaped: abdomen unarmed at the base: sternum without a ridge: legs stout; the four anterior femora with two spines beneath close to the apex, last pair much incrassated (♂), with a very long acute spine near the base, two shorter ones near the apex, and a double row of minute spines, or acute tubercles, running along the under surface (*Dallas*).

379. EUROSUS VALIDUS, Dallas.

Eurostus validus, Dallas, List Hem. i, p. 343, t. 11, f. 2 (1851); Walker, Cat. Het. iii, p. 468 (1868); Stål, En. Hem. i, p. 72 (1870).

♂. Elongate-ovate, deep chestnut, punctured: head finely rugose: pronotum minutely punctured, faintly transversely rugose, with the anterior and lateral margins, black: scutellum coarsely rugose, with the disc finely, the margins coarsely, punctured; with the lateral margins and the tip blackish: corium rather paler than the rest of the surface, very thickly and minutely punctured: membrane brownish, semitrans-

parent: margins of abdomen black: the abdomen beneath, smooth and shining, impunctate, tinted with violet; stigmata yellowish: pectus violet-black, strongly wrinkled; prostethium castaneous with a violet-black, wrinkled patch; sternum pale: legs pitchy castaneous, slightly shining, with numerous minute tubercles; tarsi paler: rostrum castaneous, with the tip black: antennæ black; apical joint bright orange, with the base black (*Dallas*). Long, 30-31 mill.

Reported from China, India (?).

380. *EUROSUS GROSSIPES*, Dallas.

Eurostus grossipes, Dallas, List Hem., i, p. 343 (1851): Walker, Cat. Het., iii, p. 468 (1868): Stål, En. Hem., i, p. 72 (1870): Distant, A. M. N. H. (5 s.) iii, p. 45 (1879).

Head, pronotum and scutellum opaque, pitchy, with a greenish tinge: pronotum faintly wrinkled transversely, with a leathery appearance; lateral margins narrowly edged with brown: scutellum coarsely wrinkled, with the whole surface also finely wrinkled and sparingly punctured; the apex much hollowed, impunctate, dull orange: coriaceous portion of the hemelytra deep pitchy brown, opaque; membrane, pale brown, opaque: margins of the abdomen of the same colour as the pronotum with a dull orange band at the base of each segment: abdomen beneath dull violet, opaque, with the lateral margins and the obtuse median ridge, pale fulvous brown: pectus dull violet, wrinkled, with the margins and the sternum brown: legs pale fulvous brown; posterior femora very stout: rostrum brown: antennæ with the basal joint brown, second black, extreme tip of fourth joint slightly ferruginous (*Dallas*). Long, 35-36 mill.

Reported from Assam, Sikkim (mihi).

Genus *MATTIPHUS*, Am. & Serv.

Hist. Nat. Ins. Hém., p. 168 (1843): Dallas, List Hem., i, p. 344 (1851); Walker, Cat. Het., iii, p. 468 (1868): Stål, Hem. Afrio. i, p. 225 (1864); En. Hem., i, p. 72 (1870).

Pronotum dilated laterally, transversely quadrate, anterior angles long, rather pointed, anterior margins slightly roundly emarginate: sternum with a rather narrow ridge, very distinct, situate between the intermediate and last pair of feet: abdomen not or scarcely extending beyond the hemelytra on each side: the other characters as in *Pycanum* (*Am. & Serv.*).

MATTIPHUS LATICOLLIS, Westwood.

Eusthenes laticollis, Westw., Cat. Hem., p. 27 (1837). Java.

Mattiphus carrenoi, Am. & Serv., Hist. Nat. Ins. Hém., p. 168 (1843). India.

Mattiphus laticollis, Dallas, List Hem., i, p. 344 (1851); Walker, Cat. Het., iii, p. 468 (1868); Stål, En. Hem., i, p. 72 (1870). Malacca.

Castaneous, shining: pronotum transverse, quadrate: scutellum castaneous-black, extreme tip whitish: antennæ blackish, apices of joints, white: sides of abdomen, black, immaculate: body beneath, with feet, luteous: abdomen shining brassy, sides with a row of transverse black lines (*Westw.*). Long, 27 millims.

Reported from Java, India, Malacca.

381. MATTIPHUS OBLONGUS, Dallas.

Mattiphus oblongus, Dallas, List Hem., i, p. 344 (1851); Walker, Cat. Het., iii, p. 468 (1868); Stål, En. Hem., i, p. 75 (1870).

♂, ♀. Above brilliant brassy green, generally becoming dull pitchy brown after death: pronotum transverse, quadrate, with the anterior angles rather less than right angles, the anterior margin nearly straight, with a small median emargination for the reception of the head; the lateral margins also nearly straight, the posterior margin gently rounded; the surface of the pronotum is faintly wrinkled transversely and minutely punctured: scutellum transversely wrinkled, and rather thickly and finely punctured: margins of the abdomen projecting beyond the hemelytra on each side, especially at the apex; the posterior angles of the apical segment very prominent, acute, making the apex of the abdomen apparently truncated, and giving an oblong form to the whole body: body beneath golden yellow: legs pale fulvous brown: antennæ darker, with the tip of the third and base of the fourth joints yellow or orange; the remainder of the fourth joint black (*Dallas*). Long, ♂ 25; ♀, 27 mill.

Reported from N. India. The Indian Museum has specimens from Assam.

382. MATTIPHUS ÆRUGINOSUS, Stål.

Mattiphus æruginosus, Stål, Trans. Ent. Soc., (3 s.) i, p. 600 (1863); En. Hem., i, p. 73 (1870); Walker, Cat. Het., iii, p. 469 (1868).

♂. Oval, above brassy-green, punctulate; pronotum transversely slightly rugose, behind the middle and the hemelytra inwards, turning into ferruginous: beneath with feet, the extremity of the apex of the scutellum, apex of third and base of fourth joint of the antennæ, also small marginal spots on the abdomen, testaceous-flavescent: pectus and

venter shining golden purplish: femora unarmed. Stature of *Pycanum rubens*, Fabr., nearest to *M. reflexus*, Dallas, from the Philippines, distinct in having the lateral margins of the pronotum straight from the apex beyond the middle, thence obtusely roundly angulate, antennæ stouter, and marking otherwise (*Stål*). Long, 21; broad, 11 mill.

Reported from Ceylon.

Genus ASIARCHA, Stål.

En. Hem., i, p. 73 (1870).

Body oval: head somewhat short, equally long and broad between the eyes; juga contiguous, rounded at the apex, lateral margins straight: ocelli scarcely twice as far from the eyes as from each other: rostrum reaching the intermediate coxæ: second joint of the antennæ longer than the third: sides of pronotum dilated: abdomen gradually slightly narrowed hindwards, apical angles of segments acute, a little prominulous, angles of sixth segment altogether prominulous hindwards, in ♂, acute: prostethium furrowed: mesostethium with a longitudinal furrowed ridge or wrinkle: metastethium elevated, anteriorly and posteriorly, narrowed, higher than the base of the mesostethium: first ventral segment elevated in the middle in a tubercle, touching the base of the metastethium: feet moderate, femora beneath with two rows of very minute teeth, last pair armed inwards near the apex with a largish spine: last tibiæ somewhat straight, as long as the femora. Near *Mattiphus*, Am. & Serv., differs in having the head shorter, more obtuse, the structure of the sterna, the angles of the last abdominal segment in ♂ acute, produced, and the first ventral segment elevated in the middle (*Stål*).

383. ASIARCHA NIGRIDORSIS, Stål.

Mattiphus nigridorsis, Stål, Trans. Ent. Soc., (3 s.) i, p. 600 (1863): Walker, Cat. Het., iii, p. 469 (1868).

Asiarcha nigridorsis, Stål, En. Hem., i, p. 73 (1870).

♂, ♀. Above black, obsolete verging into ferruginous, beneath with antennæ and feet testaceous-flavescent; extreme margin of venter black, the fourth joint of antennæ, black, flavescent at the base, the third joint (except apex) infusate: membrane greenish æneous. Allied to *M. oblongus*, Dallas, but differs in being larger, above black: pronotum more amplified forwards, lateral angles more produced, smaller, part of anterior margin reflexed, posterior angles of sixth abdominal segment produced more acutely and a little farther. Head obtuse, about as long as the intraocular breadth; pronotum gradually distinctly amplified for-

wards, lateral angles distinctly produced forwards: posterior angles of sixth abdominal segment acute (*Stål*). Long, 29; broad, 15 mill.

Reported from India, Panjab.

Genus CARPONA, Dohrn.

Stettin, Ent. Zeit., xxiv, p. 351 (1863); *Stål*, En. Hem., i, p. 74 (1870). Includes *Virbius*, *Stål*, Hem. Afric., i, p. 225 (1864).

Form of the pronotum as in *Dalcantha dilatata* Am. & Serv., the lateral margins are produced in the form of an equilateral triangle with the apex on a level with the eyes: form of the abdomen is very like that of *Pygoplatys*, Dallas, and entirely different from *Dalcantha*, Am. & Serv., moreover the metastethium is unarmed, which distinguishes it from *Pygoplatys*; likewise the abdomen is not prolonged in a thorn or spine; the last femora are a little thicker than the others and the apex of each femur has two teeth: first joint of the antennæ not reaching beyond the level of the head (*Dohrn*).

384. CARPONA ANGULATA, *Stål*.

Pycnum angulatum, *Stål*, Trans. Ent. Soc., (3 s.) i, p. 601 (1863); Walker, Cat. Het., iii, p. 471 (1868).

Virbius angulatus, *Stål*, Berlin Ent. Zeit., p. 158 (1868).

Pycnum smaragdiferum, Walker, l. c., p. 472 (1868).

Carpona angulata, *Stål*, En. Hem., i, p. 74 (1870).

♀. Subæneous-black, beneath fuscous-ferruginous, tinted brassy-green: small marginal spots on abdomen yellow-testaceous: sides of pronotum angulated, amplified, angles turned forwards, anterior margin of the lateral dilated part sinuate, lateral margins subparallel: femora beneath with two spines near the apex: last tibiæ distinctly curved (*Stål*). Long, 32; broad, 16 $\frac{1}{2}$ mill.

Reported from Siam.

385. CARPONA FUNESTA, Dohrn.

Carpona funesta, Dohrn, Stettin Ent. Zeit., xxiv, p. 351 (1863); Walker, Cat. Het., iii, p. 474 (1868); *Stål*, En. Hem., i, p. 74 (1870).

Obscurely black-piceous, opaque, very finely and densely punctured: head strongly rugose, jugæ somewhat exarcuate, tylus shorter; eyes and ocelli brownish, the latter of a lighter colour: first joint of the antennæ extending somewhat beyond the head, second joint about four times as long as the first: lateral margins of head, margins of gular plates, and base of second joint of rostrum light brown-yellow: anterior margin of pronotum is semilunately emarginate, and ends on each side in a yellow

protuberance; here also the somewhat exarcuate fore border separates from the lateral borders in a rather equilateral produced triangle which approaches the other side of the lateral margins in a rounded pointed angle of about 75° : humeral angles rounded and with the posterior half of the pronotum and the strongly rugose scutellum shining, the anterior half of the pronotum and the corium are dull: membrane dark brown with a metallic lustre: beneath dull piceous-brown, the margins of each part of the pectus, two spots in the middle of the mesostethium, the margin of the corium and a spot on the base of the margin of each abdominal segment light yellow brown: feet dark piceous-brown with prominent beaded edges. Very like *O. angulata*, Stål, and hardly specifically different: it is however, distinguished by the pronotum being more opaque, dilated part more finely and more densely rugulose, venter finely and densely punctulate, apical angles of pronotum ochraceous at the apex, prominulous in a tooth to the eyes, anterior margin of lateral dilated part of pronotum straight, at anterior angles only not entirely gradually sinuate, juga less narrowed towards the apex, there more rounded outwards. Long, 34 mill.

Reported from Cambodia.

386. CARPONA AMPLICOLLIS, Stål.

Pycnum ampicolle, Stål, Trans. Ent. Soc., (3 s.) i, p. 600 (1863); Walker, Cat. Het., iii, p. 470 (1868).

Carpona ampicollis, Stål, En. Hem., i, p. 74 (1870).

♀. Black, minutely rugulose, punctulate, beneath turning into ferruginous; pronotum transverse, lateral angles produced forwards, stature almost that of *M. oblongus*, Dallas, pronotum proportionately broader, more dilated forwards and the lateral angles more produced: 2 and 4 joints of antennæ of equal length, third somewhat longer: pronotum gradually somewhat amplified from the base forwards, then abruptly forming on both sides an angle somewhat produced forwards: scutellum more distinctly punctured than the pronotum: beneath very densely, finely rugulose punctulate: femora beneath near the apex armed with two spines, the interior spine on the last femora robust: last tibiæ slightly curved behind the middle (Stål). Long, 32; broad, 18 mill.

Reported from N. India.

387. CARPONA AMYOTI, Vollenhoven.

Pycnum amyoti, Voll., Tijdsch. voor Ent., (2 s.) i, p. 219, t. ii, f. 7 (1866); Faune Ent. P. Aroh. Indo. Néer, iii, p. 34, t. 3, f. 8 (1868); Walker, Cat. Het., iii, p. 471 (1868).

Carpona amyoti, Stål, En. Hem. i, p. 74 (1870).

Of a deep cherry-brown, a little lighter beneath: antennæ black, tip

yellow: eyes light brown, ocelli yellow: pronotum dilated, disc finely transversely rugose and irregularly punctured: scutellum distinctly rugose, its apex lighter: hemelytra very finely punctulate, the margin obscure near the base: membrane transparent brown: rostrum, marks on the pectus, the coxæ, and the reflexed margin of the hemelytra, yellowish: some small triangular white patches on the lateral margins of the abdominal segments; the sixth segment is acuminate in both sexes, the 4-6 segments a little dilated in the ♀: feet stout, with long spines on the femora (*Voll.*). Scarcely differs from the preceding, compared with Vollenhoven's figure it differs in having the angles of the dilated part of the pronotum produced much more forwards than in *C. angulata*, Stål. Long, 32; broad, 19 mill.

Reported from India (♀), Sumatra (♀).

Genus PYCANUM, Am. & Serv.

Hist. Nat. Ins. Hém., p. 171 (1843): Dallas, List Hem., i, p. 345 (1851): Walker, Cat. Het., iii, p. 470 (1868): Stål, Hem. Afric., i, p. 225 (1864): En. Hem., i, p. 75 (1864).

Head rather pointed, anterior margin slightly emarginate: antennæ long, joints rather robust, the first scarcely extending beyond the anterior margin of the head, the rest almost canaliculate, the second a little larger than the third which is as long as the fourth: rostrum reaching the middle of the space lying between the insertion of the first and that of the second pair of feet: pronotum semilunate, rather regularly rounded in front, posterior border almost straight and not produced over the scutellum, lateral margins flat and a little reflexed: no sternal ridge: scutellum rather broad at the base, but short, not reaching the middle of the abdomen; its apex very small, extended a little in form of a long square and its tip spoon-shaped: abdomen oval, margins flattened and almost foliaceous, extending on each side a little beyond the hemelytra: venter tumid: base not elevated: feet moderate; femora beneath with two more or less prominent spines at the apex (*Am. & Serv.*).

388. PYCANUM RUBENS, Fabricius.

Cimex rubens, Fabr., Ent. Syst., iv, p. 107 (1794): Stoll, Punaises, p. 21, t. 4, f. 25, 29 (1788).

Cimex amethystinus, Weber, Obs. Ent., p. 115 (1801).

Edessa amethystena, Fabr., Syst. Rhyng., p. 150 (1803).

Edessa rubens, Fabr., Syst. Rhyng., p. 151 (1803).

Tessarotoma alternata, St Farg. & Serv., Enc. Méth., x, p. 591 (1825).

Aspongopus amethystinus, Burm., Handb. Ent., ii (i), p. 351 (1835); Herr. Schäff., Wanz. Ins., iv, p. 85, t. 135, f. 417 (1839); Blanchard, Hist. Ins., p. 143 (1840).

Pycnum amethystinum, Am. & Serv., Hist. Nat. Ins. Hém., p. 172 (1843); Dallas, List Hem. i, p. 345 (1851); Walker, Cat. Het., iii, p. 470 (1868).

Didior amethystinus, Herr. Schöff., Wanz. Ins., vii. p. 76 (1844).

Pycnum rubens, Vollenhoven, Faune Ent. l'Aroh. Indo-Néer., iii, p. 32 (1868); Stål, Hem. Fabr. i. p. 40 (1868); En. Hem. i. p. 75 (1870); Distant, A. M. N. H., (5 s.) iii, p. 45, 52 (1879).

Antennæ pilose, black, last joint a little rufescent at the apex: head greenish, shining, blackish at the apex: pronotum ruddy, anterior and lateral margins virescent: scutellum greenish, shining, with a flavescent spot on the apex: hemelytra ruddy, spotless: wings obscure: abdomen reddish, last segment greenish and the margin spotted yellow: feet black (*C. rubens*, Fabr.). Head with the margin a little reflexed; juga wrinkled at their base, brown-violaceous above: antennæ black, briefly pilose; apex of the last joint slightly brownish: eyes brown, ocelli lighter: pronotum of a semicircular form, not dilated, red-brown, transversely rugose, especially posteriorly, its lateral margins reflexed: scutellum of the same colour, transversely rugose, apex yellowish: hemelytra concolorous, very finely punctulate, interior and exterior margins transversely rugose: membrane nacreous brown: the portion of the abdomen extending beyond the hemelytra has alternate yellow and black bands: body beneath ochraceous, mottled with light brown and a little violet: feet brownish, more obscure above. Long, 12-16 mill.

Var. *a*. Light yellowish brown above: borders of head and the antennæ violet grey: venter a little more violet than the type. Sumatra.

b. Rather obscure brown violet: head and anterior margin of pronotum with a dull green reflection: beneath mottled with light brown, violet and bronzy green: margin of abdomen with square alternate yellow and violet spots. Sumatra.

c. Obscure brown violet: head, anterior margin of pronotum and the scutellum of a dull green: below of a beautiful violet, with ochraceous patches: feet black. Banca, Biliton: a variety of *P. amethystinus* Fabr. and found in Assam (mihi).

d. Blackish violet: posterior margin of pronotum and posterior half of hemelytra, bronzed green: pectus brown violet; venter very deep violet, spotless; feet brown. Sumatra.

e. Head, pronotum and scutellum of a brilliant green: hemelytra cherry-red: entire body below golden green with brownish-yellow patches: margin of abdomen yellow with patches of an obscure brown: femora red: tibiae deep brown. Malacca (*Voll.*).

In Assam and Sikkim the representatives of this species are usually of an uniform ochraceous colour above.

Reported from the East. Arch., Assam, Sikkim (mihi).

389. PYCANUM PRETIOSUM, Stål.

Pycanum pretiosum, Stål, Cefvers. K. V.-A. Förh., p. 234 (1854); l. c., p. 64, t. 1 a, f. 2 (1856); l. c., p. 645 (1870); En. Hem. i, p. 75 (1870); Walker, Cat. Hat. iii, p. 471 (1868).

Pronotum, scutellum and hemelytra obscurely sanguineous, violaceous: beneath violaceous, sanguineous: anterior part of head violaceous green, rugulosely punctured; antennæ black, fulvescent at the extreme apex, last joint much longer than the preceding: pronotum broadly truncate anteriorly, sinuate behind the head, sides oblique, somewhat straight, rugosely punctured, anteriorly and with two basal spots, metallic green: scutellum rugosely punctured, green at the base on both sides, luteous at the apex: hemelytra at the apex virescent, rather finely punctulate: membrane cupreous: pectus and abdomen on both sides varied green, its margin above and below luteous, spotted black: feet obscurely fuscous, castaneous; femora spinose at the apex. Long, 26; broad, 14 mill. Reported from Penang. Hardly differs from *P. rubens*, and should belong to variety (*d*); only a slight dissimilarity in the form of the pronotum and the length of the third joint of the antennæ.

390. PYCANUM PONDEROSUM, Stål.

Pycanum ponderosum, Stål, Cefvers. K. V.-A. Förh., xi, p. 234 (1854); l. c. xiii, p. 63, t. 1 a, f. 1 (1856); Walker, Cat. Het. iii, p. 471 (1868); Stål, En. Hem. i, p. 75 (1870).

Dalcantha Sancti Fargavii, Voll., Tijdschr. Ent., (2 s.) i, p. 218, t. 11, f. 6 (1866).

♀ Sordid luteous above and beneath, scutellum and hemelytra luteous; rugosely punctured: head triangular, subemarginate at the apex, margined black: antennæ black, fulvescent at the extreme tip: pronotum transverse, equally broad, anteriorly and posteriorly, sinuate behind the head, dilated anteriorly on both sides, rugulosely punctured, except the basal margin, very narrowly margined black: scutellum rugosely punctured, more weakly luteous at the apex: hemelytra densely punctured; membrane sordid hyaline; beneath with three large patches on both sides of the pectus, one on both sides on the abdomen, oblong, broad, much sinuated inwards, metallic green: abdomen above with black marginal spots: feet obscurely castaneous, femora spinose at the apex (Stål). Long, 33; broad, 18 mill. Differs from *P. rubens*, Fabr., in being larger and stouter and in the longer last joint of the antennæ; the pronotum, moreover, is rectangular, dilated anteriorly on both sides. The *D. Sancti Fargavii*, Voll., is luteous, head and sides of pronotum margined black: abdominal limbus spotted fuscous, antennæ, black. Long, 28-35; broad, 20-21 mill.

Reported from Silhat, Assam, Dsmdim (mihi).

391. PYCANUM JASPIDEUM, Herrich Schäffer.

Pycanum jaspideum, Herr. Schöff., Wanz. Ins., ix, p. 308; t. 323, f. 1009 (1852): Walker, Cat. Het., iii, p. 470 (1868): Stål, En. Hem., i, p. 75 (1870).

Æneous-cupreous, beneath and feet obscurely testaceous: like *P. rubens*, Fabr., antennæ longer and thinner, second joint much longer than the third; first joint brown yellow, apex of third and base of fourth joint, white yellow: lateral margins of the pronotum strongly reflexed, ventricosely advanced, its surface and that of the scutellum strongly transversely rugose: feet and beneath brown-yellow without a metallic lustre: the incisures of the margin of the abdomen alone yellowish (*H. S.*). The color of the feet and marking of the antennæ in this species would place it in *Mattiphus*, but the spined femora bring it into *Pycanum*. Long, 25 mill. ♀

Reported from Assam.

392. PYCANUM (?) RUBIDUM, Walker.

Pycanum rubidum, Walker, Cat. Het., iii, p. 471 (1868).

Deep red: sides of head and pronotum, antennæ, legs and costa of the hemelytra, at the base, black: head thickly and very minutely punctured, obliquely striated on each side in front; eyes testaceous; rostrum tawny; second joint of antennæ a little longer than the third, fourth much longer than the second: pronotum transversely and finely striated, minutely and rather thinly punctured, sides slightly rounded, obliquely striated: scutellum less finely striated than the pronotum: pectus and underside of the abdomen metallic-green: luteous spots on each side of the abdomen, femora blackish red: hemelytra very thickly and minutely punctured, membrane lurid. Pronotum more dilated than in *P. rubens*, possibly only a variety (*Walker*). Long, 27½ mill.

Reported from Mount Ophir.

393. PYCANUM (?) STABILE, Walker.

Pycanum stabile, Walker, Cat. Het., iii, p. 472 (1868).

Dark dull red: sides of the head and of the pronotum, legs and costa of the hemelytra, at the base, black: head extremely minutely punctured, with an æneous tinge: rostrum piceous: pronotum transversely and finely striated, minutely and rather thinly punctured; fore part nearly smooth; sides in front longitudinally striated, dilated and forming two rounded right angles: scutellum less finely striated than the pronotum: pectus metallic green; lobes mostly bordered with tawny: abdomen with black lateral spots, underside with two very broad me-

tallic green stripes; disc longitudinally and very finely striated: hemelytra extremely minutely and thickly punctured, partly and slightly tinged with seneous-green; membrane cinereous (*Walker*). Body long, 32-33 mill.

Reported from India: appears to be intermediate between *P. ponderosum*, Stål, and *Carpona angulata*, Stål, (Siam).

394. PYCANUM (?) PALLIPES, Walker.

Pycanum pallipes, Walker, Cat. Het., iii, p. 473 (1868).

Blackish green, pale luteous beneath: head, pronotum and scutellum very thickly and minutely punctured: head pale luteous behind, and with an interrupted stripe of that hue: eyes pale luteous, with ferruginous disc: antennæ luteous; second joint more or less brown above; third brown, yellow towards the tip, much shorter than the second; fourth black, yellow towards the base, a little shorter than the second: pronotum with a very narrow luteous border, transversely and finely striated; fore part on each side much dilated, longitudinally striated, forming a well defined right angle: scutellum transversely rugulose: abdomen above purple; connexivum deep green, bordered with brown, and, at the tip, with pale luteous: hemelytra blackish, irregularly red about the borders; membrane emerald green: wings blackish cinereous (*Walker*). Body long, 25 mill.

Reported from N. India. Walker notes that it appears to be a link between *Pycanum* and *Dalcantha*, and is close to *D. stålîi*, Voll.

Genus OXYLOBUS, Stål.

En. Hem., i, p. 75 (1870).

Body ovate: head small, gradually somewhat sinuately narrowed before the eyes; juga contiguous, rounded at the apex; ocelli twice as far from each other as from the eyes: rostrum reaching middle of mesostethium: antennæ 4-jointed, fourth joint longer than the second: sides of pronotum dilated: prostethium longitudinally sulcate: mesostethium with a depressed, continued ridge or wrinkle, furrowed through its entire length: metastethium not elevated: abdomen gradually amplified hindwards, angles of segments acute, very slightly prominulous, sixth segment very broad, apical angles acute, produced to a distance: basal segments of venter not elevated in the middle: feet moderate; tibiæ straight; last pair somewhat equal to femora in length: differs from *Pycanum* in the shape of the abdomen (*Stål*).

venter and antennæ (the yellow-testaceous basal joint excepted), black. Allied to *D. dilatata*, Am. & Serv., differs in having the pronotum a little shorter, lateral part more dilated and rounded, antennæ more slender and femora unarmed (Stål). Long, 20; broad, 10 mill.

Reported from the Punjab.

The following genera and species require further examination before admitting them to the Asiatic list.

Div. •ONCOMERARIA, Stål.

Tarsi 3-jointed: apical margin of corium more or less distinctly sinuate, very rarely rounded: membrane without basal areolas, transverse basal vein emitting longitudinal veins: scutellum longer than broad, part placed far behind the frena: primary and subtended veins of wings approximate or contiguous, diverging towards the apex: hamus wanting.

Genus PRIZOSTERNUM, Amyot & Serville.

Hist. Nat. Ins. Hém., p. 161 (1843); Dallas, List Hem., i, p. 338 (1851); Walker, Cat. Het., iii, p. 437 (1868): Stål, Hem. Afric, i, p. 224, 227 (1864); En. Hem., i, p. 63 (1870). Includes *Salica*, Walker, l. c. p. 469 (1868).

Body large, obovate: head small triangular; juga longer than the tylus, and anteriorly contiguous; antenniferous tubercles entirely visible from above, very close to the eyes, a little prominulous, unarmed; bucculæ continuous, much elevated, higher in front than behind; eyes rather prominulous; ocelli near the eyes: antennæ 5-jointed, shortish, rounded, first joint extending beyond the apex of the head, second longer than the third; rostrum extending beyond the first pair of coxæ, first joint extending a little beyond the bucculæ posteriorly: lateral margins of pronotum very narrowly reflexed, basal part produced hindwards and covering base of scutellum which is triangular, longer than broad, acute at apex; frena extended beyond the middle of the scutellum: apical margin of corium sinuate, exterior apical angle acute: membrane with simple longitudinal veins, emitted from the transverse basal vein, prostethium simple: metastethium much elevated, posteriorly truncate, anteriorly produced, the produced part gradually compressly narrowed forwards, extended to the first coxæ, quiescent on the mesostethium: apical angles of the abdominal segments prominulous in a tooth; second ventral segment somewhat elevated in the middle at the base and touching the truncate posterior part of the metastethium: feet moderate last pair distant; femora unarmed; tibiæ slightly furrowed above; tarsi 3-jointed (Stål). From America and Africa.

399. *Piezosternum* (?) *firmatum*, Walker, Cat. Het. iii, p. 458 (1868).

Piezosternum cribratum, Walker, l. c., ♀, ?.

Testaceous, elongate-oval, paler beneath: head minutely punctured; rostrum extending rather beyond the first coxæ; antennæ piceous, second joint longer than the third: pronotum and scutellum thinly and roughly punctured: pronotum with an irregular smooth band near the fore border, sides transversely striated, lateral angles produced into horns which are as long as half the intermediate space, slightly inclined forwards and ascending, with black punctures towards the tips which are slightly acute; hind border rounded, extending over the base of the scutellum which is attenuated, acute, pale-greenish and slightly grooved near the tip: pectoral ridge lanceolate extending to the first coxæ: abdomen narrowly bordered black, hind angles of the apical segment forming two spines which extend a little beyond the eight intermediate spines: hemelytra rather thinly and roughly punctured with a blackish-patch on the disc: membrane pale cinereous (*Walker*). Body long, 14-15 mill. *P. cribratum* is a little smaller, horns more inclined forwards and scutellum smaller.

Reported from Malacca.

400. *Piezosternum* (?) *ingenuum*, Walker, Cat. Het. iii, p. 459 (1868).

Testaceous: head minutely punctured; rostrum extending a little beyond the first coxæ, tip black; antennæ luteous, less than half the length of the body, 2-3 joints about equal in length, fourth longer than the third: pronotum and scutellum thinly and roughly punctured, minutely and transversely striated along each side; horns directly diverging, with blackish punctures, rounded at the tips, longer than their breadth at the base; hind border rounded, extending over the base of the scutellum which is acute, grooved and much attenuated towards the tip: the pectoral ridge lanceolate, extending to the first pair of coxæ, notched at the base: hind angles of the apical segment of the abdomen elongated, acute, not extending beyond the anal appendages: hemelytra very thickly and minutely punctured, with variable rosy patches: membrane pale cinereous (*Walker*). Body long, 19 mill.

Locality not given (Malacca ?).

Genus *MUSCANDA*, Walker.

Cat. Het. iii, p. 576 (1868).

Body nearly elliptical, thickly and rather roughly punctured: head small, conical in front, a little longer than broad; jugs contiguous much beyond the tylus; eyes prominent; rostrum stout, extending to the first

coxæ; antennæ slender, a little more than half the length of the body first joint extending to the front of the head, second a little shorter than the third, fourth much longer than the third, fifth shorter than the fourth: pronotum with a slight transverse ridge between the horns which are broad, slightly tapering, truncated at the tips, slightly ascending, extending obliquely forward, about half the length of the intermediate breadth of the pronotum; a transverse callus on each side in front: scutellum a little less than half the length of the abdomen, attenuated towards the apex which is rounded: pectus without a ridge; abdomen without a ventral spine: legs rather long and slender: membrane with longitudinal veins some of which are fuscate. Distinguished from *Piezosternum*, A. & S., by the long horns of the thorax and the much less acute scutellum (*Walker*).

401. *MUSCANDA TESTACEA*, Walker.

Muscanda testacea, Walker, Cat. Het. iii, p. 577 (1868).

Testaceous including eyes: abdomen thinly punctured on the disc beneath, where there are black points along each side on the hind angles of the segments: membrane cinereous (*Walker*). Body long, 21 mill.

Reported from Darjiling.

Genus *BESSIDA*, Walker.

Cat. Het. iii, p. 577 (1868).

Body elongate-oval, thickly and somewhat roughly punctured: head longer than broad, narrow and rounded in front; juga contiguous much beyond the tylus; eyes small, not prominent: rostrum extending to the first coxæ; antennæ slender, about one-third of the length of the body; first joint not extending to the front of the head, second very much longer than the third, fourth longer than the third, fifth a little longer than the fourth: pronotum with a small slight transverse ridge between the horns which are stout, acute, very slightly inclined forwards and not longer than their breadth at the base; transverse callus on each side near the fore border; sides straight, slightly serrate: scutellum attenuated, rounded at the tip, more than half the length of the abdomen which is truncated at the tip: legs moderately long and stout (*Walker*).

402. *BESSIDA SCUTELLARIS*, Walker.

Bessida scutellaris, Walker, Cat. Het., iii, p. 578 (1868).

Ferruginous, ochraceous beneath: antennæ, scutellum, abdomen

and legs ochraceous: membrane lurid (*Walker*). Body long, $12\frac{1}{2}$ -13 mill.

Reported from Burma.

Subfam. DINIDORINA, Stål.

En. Hem. i, p. 79 (1870); *Ofvers. K. V.-A. Förh.* (3), p. 32 (1872):—*Edessida*, pt., Dallas, List Hem. i, p. 316 (1851); *Dinidorida*, Stål, *Ofvers. l. c.* p. 522 (1867).

a, b, as in Subfam. PENTATOMINA (Jl. Pt. II, p. 192, 1887).

(c)—Scutellum never extending beyond the middle of the dorsum of the abdomen, apical part broad: hemelytra and wings usually complete, rarely abbreviated: membrane very large: primary and subtended veins of wings distant, converging at the apex, the space between not amplified there.

Genus CYCLOPETA, Amyot & Serville.

Hist. Nat. Ins. Hém., p. 172 (1843); Dallas, List Hem., i, p. 346 (1851); Walker, Cat. Het., iii, p. 477 (1868); Stål, En. Hem., i, p. 80 (1870):—Includes *Dinidor*, Stål, (*nec Latr.*), Hem. Afric., i, p. 81, 211 (1864).

Head rather broad, but small, almost straightly truncated and slightly emarginate in front; juga longer than the tylus; eyes small, prominulous; ocelli very distinct: antennæ rather long, 4-jointed, rather flattened; first joint short, though extending a little beyond the anterior margin of the head, second longer than the third which is a little shorter than the fourth: rostrum reaching the insertion of the middle pair of feet: pronotum almost semicircular anteriorly, the posterior margin slightly rounded: scutellum scarcely reaching the middle of the abdomen, its apex broad and lunately rounded: membrane with irregular areolas formed of transverse and longitudinal veins, not extending beyond the apex of the abdomen: the abdomen broad, rounded posteriorly, margins flat and extending on each side beyond the hemelytra; feet moderate, rather robust: femora with some spines beneath towards the apex (*Am. & Serv.*).

403. CYCLOPETA OBSCURA, St. Farg. & Serville.

Tessaratomia obscura, St. Farg. & Serv., Enc. Méth, x, p. 592 (1826). Java.

Aspongopus alternans, Westwood, Hope, Cat. Hem., i, p. 26 (1837).

Aspongopus depressicornis, Herr. Schöff., Wanz. Ins., iv, p. 85, t. 135, f. 418 (1839).

Dinidor depressicornis, Herr. Schöff., l. c., vii, p. 76 (1844).

Cyclopelta obscura, Am. & Serv. Hist. Nat. Ins. Hém., p. 173 (1843); Dallas, List Hem., i, p. 347 (1851); Walker, Cat. Het. iii, p. 479 (1868); Vollenhoven, Faune. Ent. l'Arch. Indo-Néer., iii, p. 37 (1868); Stål, En. Hem. i, p. 80 (1870); *Ofvers. K. V.-A. Förh.*, p. 645 (1870); Distant, J. A. S. B., xlviii (2), p. 37 (1879); Lethierry, An. Mus. Gen., xviii, p. 649 (1883).

♀. Body entirely dull brown mingled with shades of reddish;

antennæ black: abdomen scarcely denticulate on the lateral margins, upper border black with red patches, lower, red with black patches: femora with two small spines placed side by side near the apex and others along them (*Serv.*). *A. depressicornis*, Herr. Schaff., is described as:—Fuscous, ovate; above very flat, coriaceous, coarse, dark red-brown, dull; fore-border of pronotum and both the humeral protuberances smoother, redder: antennæ 4-jointed, 2-3 joints depressly dilated: spots at base and apex of scutellum and on the connexivum, orange: venter convex, smoother, sordid orange varied brown: feet castaneous.

This species varies much in colour: sometimes blackish, sometimes obscurely ferruginous, beneath paler, sometimes ferruginous-flavescent; connexivum and ventral limbus marked with ferruginous or yellow-ferruginous spots: basal spot on the scutellum distinct [sometimes absent]. Long, 14-15 mill.

Reported from Assam, Sikkim (mihi), Calcutta, Madras: China, Philippines, Malacca, Java, Borneo.

404. CYCLOPETA TRIMACULATA, Vollenhoven.

Cyclopelta trimaculata, Voll., Faune Ent. l'Arch. Ind. Néerl, iii, p. 37, t. 4, f. 4 (1868); Stål, En. Hem., i, p. 80 (1870).

Black-purplish: a small line or oblong spot on the side of the pronotum, triangular spot at base of scutellum united by a median line with a spot on the apex and two submarginal streaks on venter, yellow: rostrum, feet and border of connexivum, red (*Voll.*). Probably only a local variety. Long, 13-16 mill.

Reported from Malacca, Borneo.

405. CYCLOPETA TARTAREA, Stål.

Cyclopelta tartarea, Stål, Ofvers. K. V.-A. Förh., p. 234 (1854); l. c. p. 64 (1856); Walker, Cat. Het., iii, p. 480 (1868); Stål, En. Hem. i, p. 80 (1870); Distant, A. M. N. H. (5 s.) iii, p. 45 (1879).

♂. Entirely blackish or subcupreous blackish above, coriaceous, punctured, transversely rugose: sometimes a minute sanguineous spot at the base of the scutellum: membrane fuscous ochraceous: beneath black, somewhat shining ærugineous. Differs from *C. obscura*, only in having the connexivum concolorous, neither broadly red, nor spotted black, and in the feet being more obscure. Long, 15; broad, 9 mill. Reported from Himálaya, Bombay, Ceylon, very common in Sikkim (mihi). Long, 10-11 mill. I have an entirely black small species from Vizagapatam and Dehra Dun. On the whole, the links between these three species are rather fairly established, and the two latter may be

considered local varieties. The uniform blackish variety being more common in India and those with yellow spots on pronotum, scutellum and connexivum being more common in Burma and southwards.

Genus ASPONGOPUS, Laporte.

Ess. Hém., p. 58 (1832); pt. Am. & Serv., Hist. Nat. Ins. Hém., p. 173 (1843); Herr. Schöff., Wanz. Ins. vii, p. 77 (1844); Dallas, List Hem. i, p. 348 (1851); Walker, Cat. Het., iii, p. 480 (1868); Stål, Hem. Afric. i, p. 81, 212 (1864); En. Hem. i, p. 81 (1870). Includes, *Spongopodium*, Spinola, Ess. Hém., p. 305 (1837):—*Amacosia*, Spin., Gen. Ins. Artr. p. 118 (1852):—*Peltagopus*, Signoret, A. S. E. F. (3 s.), viii, p. 396 (1861).

Body oval or ovate: head small, subfoliaceous, juga sometimes a little longer than the tylus; bucculæ much elevated, foliaceous, sub-semicircular: rostrum extended almost to the intermediate coxæ, first joint extending beyond the bucculæ: antennæ 5-jointed: lateral angles of pronotum not prominent, obtuse: apical part of scutellum, broad: frena extended to or a little beyond the middle of the scutellum: veins of membrane more or less anastomosed: venter unarmed at the base; feet robust, femora often spinulose (Stål).

Stål distributes the species of this genus amongst the subgenera *Colpoproctus* and *Aspongopus*. The first is found in Africa, the second in India, and is distinguished by having the head subequilateral or scarcely transverse, the lateral margins straight or slightly sinuated, the eyes not stylated: the anal segment, in ♂, is entire at the apex, rounded, and is rarely furnished with an obsolete sinus in the middle.

406. ASPONGOPUS BRUNNEUS, Thunberg.

Cimeæ brunneus, Thunberg, Nov. Ins. Spec., ii, p. 45 (1783); Gmelin, ed. Syst. Nat., i, (4), p. 2158 (1778).

A. (Aspongopus) brunneus, Stål, En. Hem. i. p. 82 (1870); Distant, A. M. N. H. (5 s.), iii, p. 45, 52 (1879).

Above brunneous, beneath fuscous, antennæ pilose (Thunb.): closely allied to and frequently confounded with *A. obscurus*, Fabr., it is thus differentiated by Distant (l. c.).

Abdomen above red.

Third joint of the antennæ, a little longer than the second, *brunneus* Thunb.

Abdomen above black.

Second and third joints of the antennæ equal. *obscurus*, Fabr. Long, 16-17; broad, 10 mill.

Reported from India, Assam.

407. *ASPONGOPUS* *OBSCURUS*, Fabricius.

Cimex obscurus, Fabr., Ent. Syst., iv. p. 107 (1794).

Edessa obscura, Fabr., Syst. Rhyng. p. 151 (1803); Wolff, Ic. Cim., p. 177, f. 171 (1811).

Aspongopus obscurus, Burm., Handb. Ent., ii (i), p. 352 (1835); Herr. Schäff., Wanz. Ins., vii. p. 80 (1844); Dallas, List Hem., i. p. 349 (1851); Walker, Cat. Het., iii, p. 482 (1868); Vollen., Faune Ent. l'Arch. Inds. Néerl., iii, p. 38 (1868); Stål, Hem. Fabr., i, p. 38 (1868).

A. (Aspongopus) obscurus, Stål, En. Hem. i, p. 82 (1870).

Body, wings and feet, fuscous: pronotum, hemelytra and scutellum obscurely olivaceous: head and antennæ (except the yellow last joint) black: anterior margin of pronotum fuscous: scutellum more obscure at the base: margins of abdomen obsoletely spotted yellow (*Fabr.*).

♀. Yellow-castaneous, shining somewhat cupreous, densely punctured: antennæ black, last joint yellow-testaceous: margins of pronotum concolorous: upper and lower marginal spots on the abdomen, castaneous-flavescent: dorsum of abdomen testaceous: wings sordid yellow, violaceous-fuscous at the apex (*Stål*). Long, 17; broad, $9\frac{2}{3}$ mill.

Reported from Australia, Celebes, Aru, Bouru, Java, India, Ceylon, N. Bengal, Silhat, Pondicherry: Assam (mihi), Sikkim (mihi), Calcutta.

408. *ASPONGOPUS* *JANUS*, Fabricius.

Cimex Janus, Fabr., Syst. Ent., p. 714 (1775); Spec. Ins., ii, p. 357 (1781); Mant. Ins., ii, p. 295 (1787); Gmelin, ed., Syst. Nat., i (4), p. 2152 (1788); Fabr., Ent. Syst., iv. p. 107 (1794); Wolff, Ic. Cim., i, p. 13, t. 2, f. 13 (1800); Stoll, Punaises, p. 30, t. 6, f. 41 (1788).

Cimex afer, Drury, Ill. Nat. Hist., iii, p. 66, t. 46, f. 7 (1782).

Cimex surinamensis, Gmelin, ed. Syst. Nat., i (4), p. 2134 (1788).

Edessa Janus, Fabricius, Syst. Rhyng., p. 151 (1803).

Pentatoma Janus, St. Farg. & Servillo, Enc. Méth., x, p. 56 (1825).

Aspongopus vicinus, Westwood, Hope, Cat. Hem., i, p. 25 (1837).

Aspongopus Janus, Lap., Ess. Hém. p. 58 (1832); Burm., Handb. Ent. ii (i), p. 352 (1835); Am. & Serv., Hist. Nat. Ins. Hém., p. 173 (1843); Herr. Schäff., Wanz. Ins., vii, p. 78, t. 240, f. 747 (1844); Dallas, List Hem., i, p. 348 (1851); Walker, Cat. Het. iii, p. 482 (1868); Distant, A. M. N. H., (5 s.) iii, p. 45 (1879).

A. (Aspongopus) Janus, Stål, En. Hem., i, p. 83 (1870).

Head deep black, immaculate: pronotum rufous, anterior segment black, elevated margin rufous: scutellum black, rufous at the apex: hemelytra rufous; wings black: abdomen black with the elevated margin, rufous: feet black (*Fabr.*). *A. vicinus*, Westw., differs only in the smaller size and the rufescent colour being more luteous. Long, 16 mill.

Reported from Philippines, Java, Borneo, Siam, India, N. Bengal,

Assam, (mihi), Tranquebar, Bombay, Karachi (mihi), Trivandrum (mihi).

409. *ASPONGOPUS OCHREUS*, Westwood.

Aspongopus ochreus, Westw., Hope Cat Hem, i, p 25 (1837) Walker, Cat Het., iii, p 483 (1868). Stål, En. Hem, i, p 85 (1870) Distant, A. M. N. H., (5 s) iii, p 45, 52 (1879).

Entirely luteous-ochraceous · pronotum and scutellum transversely rugose : antennæ and feet fuscous · last joint of antennæ and tarsi pale : body beneath concolorous (*Westw.*). Long, 17-18 mill.

Reported from Bengal.

410 *ASPONGOPUS SICCIFOLIUS*, Westwood.

Aspongopus siccifolius, Westw., Hope, Cat Hem, i, p 26 (1837) Stål, En Hem., i, p 85 (1870) Distant, A. M. N. H. (5 s) iii, p 45 (1879)

Cyclopelta nicosolia, Dallas, List Hem, i, p 347 (1851) Walker, Cat Het, iii, p 479 (1868).

Obscurely coppery-fuscous, very much punctured, antennæ short, apical joint pale, membrane luteous-fulvous, irregularly reticulated with concolorous veins, pronotum transversely subfoveolate, first femora denticulate beneath (*Westw.*) Body long, 14½-15 mill.

Reported from Ceylon, India, Gogo, N. Bengal, Assam.

411. *ASPONGOPUS NIGRIVINIRIS*, Westwood.

Aspongopus nigriuentis, Westw., Hope, Cat Hem, i, p 26 (1837) ; Dallas List Hem, i, p 349 (1851), Walker, Cat Het, iii, p 482 (1868), Vollenhoven, Faune Ent. l'Arch Indo Néerl, iii, p 39 (1868) Stal, En Hem, i, p 85 (1870) Distant, A. M. N. H., (5 s), iii, p 45 (1879)

Altogether black-fuscous, above just tinted with cupreous, very finely punctured · pronotum transversely substriated · membrane with about twelve longitudinal veins of which some are forked · last tibiæ, a little dilated in the middle (*Westw.*). Long, 17-18 mill. *A. chinensis*, Dallas (List l. c.), differs almost only in having the second joint of the antennæ much longer than the third and may perhaps be united with this. ♂, long, 17-18, ♀, long, 18-19 mill.

Reported from China, Borneo, Sulu, India, Silhat, Assam, Sikkim (mihi).

412. *ASPONGOPUS SANGUINOLENTUS*, Westwood.

Aspongopus sanguinolentus, Westwood Hope, Cat. Hem, i, p 26 (1837), Dallas, List Hem, i, p 350 (1851), Walker, Cat Het, iii, p 483 (1868), Stål, En Hem, i, p. 85 (1870).

Closely allied to *A. nigriuentis*, Westw, differs especially in having

the abdominal margin sanguineous, last tibiæ simple, and the veins of the membrane less regular and more forked (*Westw.*). Long, 14-15 mill.

Reported from India, Java.

413. *ASPONGOPUS FUSCUS*, Westwood.

Aspongopus fuscus, Westwood, Hope, Cat. Hem., i, p. 26 (1837); Dallas, List Hem., i, p. 349 (1851); Walker, Cat. Het., iii, p. 483 (1868); Stål, En. Hem., i, p. 85 (1870); Öfvers. K. V.-A. Förh., p. 645 (1870).

Closely allied to *A. sanguinolentus*, Westw., and perhaps only a variety of that species; colour more piceous, and interrupted on the luteous sides of the abdomen by black dots; membrane with more areolas at the base (*Westw.*). Long, 15½-16 mill.

Reported from Java.

414. *ASPONGOPUS NEPALENSIS*, Westwood.

Aspongopus nepalensis, Westwood, Hope, Cat. Hem., i, p. 26 (1837); Dallas, List Hem., i, p. 349 (1851); Walker, Cat. Het., iii, p. 483 (1868); Stål, En. Hem., i, p. 85 (1870); Distant, A. M. N. H. (5 s.), iii, p. 45 (1879).

Allied to but much longer than *A. nigriventris*, Westw., altogether fuscous-piceous: membrane concolorous with about 12 veins, some of which are forked and areolated at the base: sides of the pronotum almost straight (oblique); last tibiæ a little dilated before the middle (*Westw.*). Long, 18-19 mill.

Reported from Nepál, Silhat, Assam, common in Sikkim (mihi).

415. *ASPONGOPUS UNICOLOR*, Dallas.

Aspongopus unicolor, Dallas, List Hem., i, p. 349 (1851); Walker, Cat. Het., iii, p. 480 (1868); Stål, En. Hem., i, p. 85 (1870).

♀. Closely resembles *A. obscurus*, Fabr., entirely fuscous except the black antennæ: body beneath paler than the upper surface: legs brown, posterior tibiæ dilated before the middle and with a long oval pit on the dilated portion: antennæ black with the basal joint brown. Long, 16½-17 mill.

Reported from India?

416. *ASPONGOPUS MARGINALIS*, Dallas.

Aspongopus marginalis, Dallas, List Hem., i, p. 350 (1851); Walker, Cat. Het., iii, p. 483 (1868); Stål, En. Hem., i, p. 85 (1870).

♂. Black piceous, somewhat obscure: pronotum and scutellum very thickly and minutely punctured and faintly wrinkled transversely:

membrane brownish: margins of the abdomen banded with black and orange, the middle of each segment being orange: the abdomen is thickly and finely punctured beneath; the margins orange with a black spot on each of the sutures: legs black: antennæ black with the apical joint bright orange; second joint much shorter than the third (*Dallas*). Long, 16-16½ mill.

Reported from Tenasserim.

417. *ASPONGOPUS CIRCUMCINCTUS*, Walker.

Aspongopus circumcinctus, Walker, Cat. Hct., iii, p. 483 (1868).

Aeneous-black, thickly and very finely punctured, brassy-piceous beneath: eyes piceous: rostrum tawny: antennæ black, second joint a little longer than the third; fourth longer than the second; fifth a little shorter than the fourth: sides of pronotum and of abdomen, testaceous, deeper on the latter: pronotum and scutellum transversely and very slightly striated, the latter piceous at the tip: corium piceous, membrane lurid (*Walker*). Long, 15-16 mill. Allied to *A. Mulleri*, Voll, (Java), but differs in the dark colour of the head and of the under-side of the body and is probably only a local variety.

Reported from India.

418. *ASPONGOPUS NIGRO-AENEUS*, Reuter.

Aspongopus nigro-aeneus, Reuter, Ent. Mon. Mag. xvii, p. 234 (1881).

Entirely brassy-black: head, pronotum and scutellum densely and finely punctured, obsoletely transversely rugose: sides of head distinctly sinuate: second joint of the antennæ a little over half longer than the first, 2-3 compressed, third longer than the second: apical margin of the corium slightly rounded: prostethium triangularly impressed in the middle, margins of impression scarcely reflexed. Differs from *A. ochreous*, Westw., in the colour, the impression on the prostethium, being less deep, the denser punctuation, and the faint wrinkles (*Reuter*). Long, 16½ mill.

Reported from Siam.

Genus *MEGYMENUM*, Laporte.

Ess. Hém., p. 52 (1832): Boisdu, Voy. Astrolabe, Ins., ii, p. 632 (1835): Guérin, Voy. La Coquille, Ins., ii, p. 171 (1838): Stål, ofvers. K. V.-A. Förh., p. 522 (1867): En. Hem., i, p. 86 (1870). Includes:—*Pseudaradus*, Burm., Silb. Rev. Ent., ii, p. 19 (1884): *Amaurus*, Burm., Nov. Act. Acad. Leop. xvi, Suppt. p. 294 (1834): *Platydius*, Westw., Zool. Journ. v., p. 446 (1835).

Head large or somewhat so; juga much longer than the tylus and

contiguous before it: antennæ 4-jointed, 2-3 joints much compressed: mesostethium deeply furrowed: bucculæ much elevated, rounded: spiracula of the first ventral segment visible.

Stål distributes the species of this genus amongst the subgenera *Pseudaradus*, *Megymenum*, *Anoplocephala* and *Pissistes*. The two first are found in India, the third in the Eastern Archipelago and the last in China.

Pseudaradus:—Head with the sides tumid at the eyes, unarmed: pronotum anteriorly with a tubercle in the middle: lateral margins of the abdominal segments distinctly produced posteriorly in a lobe or tooth; prominulous before the middle, or almost in the middle, in a tooth, or small very obtuse lobule; 2-3 joints of antennæ amplified on both sides.

Megymenum:—Head furnished before the eyes on both sides with a tooth, or, oftenest, a very distinct spine: pronotum anteriorly in the middle not, or only very slightly, tumescent: lateral margins of abdominal segments posteriorly distinctly produced in a lobe or tooth, prominulous before the middle, or, in the middle, in a tooth, or very obtuse small lobule: 2-3 joints of the antennæ amplified on both sides.

Div. PSEUDARADUS.

419. MEGYMENUM BREVICORNE, Fabricius.

Cimex brevicornis, Fabr., Mant. Ins., ii, p. 294 (1787); Gmelin, ed. Syst. Nat., (4), p. 2152 (1788).

Edessa brevicornis, Fabr., Syst. Rhynch., p. 154 (1803).

Amaurus brevicornis, Burmeister, Handb. Ent., ii (i), p. 350 (1835).

Megymenum brevicorne, Dallas, List Hem., i, p. 364 (1851); Walker, Cat. Het. iii, p. 500 (1868); Stål, Hem. Fabr., i, p. 38 (1868).

M. (Pseudaradus) brevicorne, Stål, En. Hem., i, p. 83 (1870).

Ovate, obscurely cupreous or brassy-black: head black, much canalliculate; antennæ short, compressed: pronotum with the sides expanded, spine anteriorly acute: scutellum and hemelytra obscurely cupreous, immaculate: wings sordidly whitish, abdomen above black, beneath cupreous: feet blackish, first pair of femora dentate inwards (*Fabr.*). Closely allied to *M. inerme*, Herr. Schöff., differs in having the 2-3 joints of the antennæ broader, the former shorter, the latter longer, and the 3-4 joints together longer than the second. The pronotum is unarmed, margins bisinuate; margin of abdomen somewhat dentated. Long, 15 mill.

Reported from China, Assam.

420. MEGYMENUM INERME, Herr. Schäffer.

Amaurus inermis, Herr. Schöff., Wanz. Ins., v. p. 62, t. 163, f. G. H. (1839).

Megymenum inermis, Dallas, List Hem., i, p. 364 (1851); Walker, Cat. Het., iii, p. 501 (1868); Distant, A. M. N. H. (5 s.), iii, p. 45 (1879).

M. (Pseudaradus) inermis, Stål, En. Hem., i, p. 86 (1870).

Hardly differs from *M. subpurpurascens*, Westw., except in having the antennæ smaller or more slender, the spines on the anterior angles of the pronotum entirely obtuse, also the angles a little prominent. Long, 15 mill.

Reported from Bengal, Assam, China.

Div. MEGYMENUM.

421. MEGYMENUM SUBPURPURASCENS, Westwood.

Platydius subpurpurascens, Westwood, Zool. Journ., v, p. 446, t. 22, f. 8 (1834).

Megymenum cupreum, Guérin, Voy. La Coquille, Zool. Ins., ii, p. 172 (1838); Am. & Serv., Hist. Nat. Ins. Hém., p. 182, t. 3, f. 10 (1843); Dallas, List Hem., i, p. 363 (1851); Vollenhoven, Faune Ent. l'Arch. Indo-Néer., iii, p. 47, t. 4, f. 8 (1868); Walker, Cat. Het., iii, p. 504 (1868).

Amaurus cupreus, Herr. Schöff., Wanz. Ins., v. p. 61, t. 163, f. 503 (1839).

Megymenum meratii, Le Guillou, Rev. Zool., p. 261 (1841).

M. (Megymenum) subpurpurascens, Stål, En. Hem., i, p. 87 (1870).

Head, pronotum, scutellum and corium, fuscous-purple: membrane fulvescent and obscurely veined: antennæ and feet black: body beneath purple (*Westw.*). In stature approaching *M. brevicorne*, Fabr., but very close to *M. spinosum*, Burm., from which it differs chiefly in having the angulose posterior part of the pronotum prominulous in a small tooth and the scutellum a little amplified behind the lateral sinus. Le Guillou's, *M. meratii* is described as:—Fuscous black, pronotum with anterior angles acute, lateral margins anteriorly deeply sinuate, dilated behind the sinus: margin of abdomen sinuate, somewhat dentate. Long, body, $14\frac{1}{2}$ -15 mill.; breadth of the abdomen, $8-8\frac{1}{2}$ mill.

Reported from New Guinea, Celebes, Ceram, Borneo, Java, Philippines, Siam, Cambodia, Penang, India, Silhat (mihi).

Genus THALMA, Walker.

Cat. Het., iii, p. 503 (1868).

Body elliptical, convex, very thickly and minutely punctured: head not longer than broad; juga contiguous beyond the tylus, rounded on the outer side and the tips, a porrect spine on each side before the eyes which are not prominent: rostrum reaching the last coxæ: antennæ 4-jointed dilated; 2-3 joints dilated; the third much shorter than the second;

fourth fusiform, slender, shorter than the third: pronotum unarmed, sides rounded, posterior angles not prominent, posterior border slightly rounded: scutellum less than half the length of the abdomen, much rounded at the apex: abdomen with the upper apical membrane entire; two broad laminæ beneath: legs stout: tarsi 2-jointed, second joint much longer than the first: hemelytra reaching the apex of the abdomen: membrane with five longitudinal veins and with a few transverse veins. Differs from *Megymenum*, in the structure of the pronotum, the less reticulated membrane, the stouter body and the sides of the abdomen not dentate.

422. THALMA BIGUTTATA, Walker.

Thalma biguttata, Walker, Cat. Het., iii, p. 503 (1868).

Purplish black, dingy ochraceous beneath: antennæ black, last joint luteous at the apex: pronotum tinged metallic-green on each side: a luteous dot at base and apex of scutellum: beneath punctured black, pectus with three irregular black stripes faintly visible on the venter: abdomen above with luteous spots along each side: legs black: hemelytra blackish; corium beneath dingy testaceous; wings purplish blue (*Walker*). Long, $16\frac{3}{4}$ mill.

Reported from Amboina, Burma (?).

Genus ATELIDES, Dallas.

A. M. N. H., (2 s.) x, p. 359, 436 (1852): Walker, Cat. Het., iii, p. 500 (1868): Stål, Öfvers. K. V.-A. Förh., p. 522 (1867); En. Hom., i. p. 89 (1870).

Body somewhat ovate, broadest behind the middle: head foliaceous; juga reflexed at the sides, much longer than the tylus, with their inner margins contiguous throughout nearly their whole length, gaping slightly at the apex; tylus very small; lateral margins with a strong spine in front of the eyes: eyes very prominent: ocelli small, placed close to the base of the head and about equally distant from one another and from the eyes: antennæ 4-jointed, stout, basal joint short, not extending beyond the apex of the head; 2-3 joints prismatic; the second longer than 3-4 together, furnished with three longitudinal furrows; third joint black and hirsute like the second; fourth orange, somewhat pilose, with the base black, perhaps a little longer than the third, elliptical, elongate; 3-4 joints much thinner than the second: rostrum rather slender, reaching the intermediate coxæ, inserted about the middle of the under surface of the head, between two somewhat triangular lamellæ; basal joint rather stout, passing the anterior margin of the prosternum; second joint longest, thinner than the first; third joint shorter than the first, about equal to it in thickness; fourth joint shortest and thinnest:

pronotum subquadrate, rather narrower in front than behind, lateral angles slightly spinose : scutellum short and broad, with the apex broad and rounded : hemelytra very short, covering only the two first segments of the abdomen (not always), with their apical margin truncated, somewhat membranous : sternum with a narrow longitudinal canal : abdomen nearly circular, slightly convex above, very convex beneath, with the apex somewhat truncated : the two lateral vulvar plates bearing stigmata : legs stout, femora unarmed ; tibiæ prismatic, the posterior pair slightly dilated internally and channelled beneath ; anal apparatus, in ♂, seen from beneath, appears to consist of a plate of a semicircular form, broadly notched on its posterior margin and occupying a broad emargination of the last segment of the abdomen ; seen from above, it presents a circular corneous ring, the upper portion of which is very narrow, whilst the lower portion is produced and emarginate posteriorly : the opening of the ring is narrowed irregularly by a large tooth on each side, close to which the margin of the ring is clothed with yellowish hairs.

423. *ATELIDES CENTROLINEATUS*, Dallas.

Atelides centrolineatus, Dallas, A. M. N. H., (2 s.) x, p. 306, 436, t. 5, f. 1-5 (1852): Walker, Cat. Het., iii, p. 500 (1868) : Stål, En. Hem., i, p. 89 (1870).

♀. Head above, brassy black, somewhat obscure, rather finely rugose, with the lateral margins tinged with chestnut, and with a longitudinal orange yellow band down the middle ; beneath brownish fulvous, with the orbits brassy : eyes brown ; ocelli yellow : antennæ with the first two joints black, thickly clothed with short stiff hairs, but with the furrows of the second joint naked ; basal joint fulvous at the base ; apical joint fulvous : rostrum pale chestnut with the basal joint fulvous : pronotum blackish, somewhat brassy, with the annular spots near the anterior margin and an indistinct patch within each lateral angle chestnut, the surface minutely punctured and wrinkled transversely ; the disc with a smooth orange-yellow band continuous with that on the head ; the sides broadly margined with dull orange, with the extreme edges black : scutellum black, very thickly and minutely punctured and transversely wrinkled, with a smooth orange-yellow band continuous with that on the thorax : pectus brownish fulvous, sparingly punctured, with a broad, brassy black, rugose longitudinal band on each side within the lateral margins : legs pale chestnut brown : hemelytra blackish, somewhat brassy, finely granulose ; outer margin broadly fulvous, edged with black ; the submarginal vein, a streak on the disc and the base of the inner margin fulvous ; membrane brown : abdomen above blackish, somewhat brassy, finely granulose, with the sides dull chestnut irrorated with black points ; the middle with a longitudinal orange band continuous

with that on the scutellum: margins pale chestnut-brown, with the edges and a band on each of the sutures black; abdomen beneath pale chestnut-brown, minutely granulated, with a blackish brassy band down each side within the line of stigmata: stigmata black; apical and lateral vulvar plates edged with black (*Dallas*). ♀, long, 19-20; ♂, 16-17 mill.

Reported from Silhat. The Indian Museum has specimens from Assam.

Add:—*Sagriva vittata*, Spin., Gen. Ins. Art., p. 117 (1852).

Subfam. PHYLLOCEPHALINA, Stål.

Öfvers. K. V.-A. Förh., p. 645 (1870); l. c. (3), p. 32 (1872): En. Hem., v, p. 117 (1876):—*Phyllocephalidæ*, Dallas, List Hom., i, p. 350 (1851):—*Phyllocephalida*, Stål, Hem. Afric., i, p. 32, 234 (1864).

(a) As in Subfam. PENTATOMINA (Jl. Pt. II, p. 192, 1887).

(b)—Rostrum short, not extended behind the first coxæ, two basal joints very short, entirely, or for the greatest part, hidden between the bucculæ: head usually foliaceous or elongated and triangular, with the juga produced to a distance before the tylus, and usually contiguous: spiracula of the basal ventral segment hidden by the posterior part of the metastethium: tarsi 3-jointed: antennæ 5-jointed.

Genus CRESSONA, Dallas.

List Hem., i, p. 358 (1851): Walker, Cat. Het., iii, p. 494 (1868): Stål, Hem. Afric., i, p. 234 (1864); En. Hem., v, p. 117, 118 (1876).

Body oblong, ovate: head small, gradually narrowed anteriorly, rounded at the apex, sides less strongly dilated; juga contiguous at the apex, not much longer than the tylus; entire antenniferous tubercles prominulous beyond the sides of the head: eyes moderate; ocelli distant, placed very close to the eyes: antennæ 5-jointed, about as long as the head and pronotum, rather stout, basal joint short and stout, passing the apex of the head, remainder nearly equal in length: rostrum 4-jointed, passing the anterior coxæ, rather stout, basal joint very short, entirely concealed within the deep groove on the underside of the head, third joint longest, fourth a little longer than the second: furrow of the orifices long: pronotum with the lateral angles produced into long, stout, straight horns which project forwards beyond the apex of the head and are somewhat compressed towards the apex which is notched; lateral margins of the pronotum strongly dentate, the denticulations continued along the under surface of the lateral horns and terminating a little before the apex of these in a large flat tooth: scutellum of the usual form

and size; frena extended beyond the middle of the scutellum: membrane with longitudinal veins: legs stout, tibiæ quadrangular with the angles prominent, especially on the anterior pair; tarsi 3-jointed, basal joint longest (*Dallas*).

424. *CRESSONA VALIDA*, Dallas.

Cressona valida, List Hem., i, p. 358, t. 11, f. 3, (1851); Walker, Cat. Het., iii, p. 494 (1868); Stål, En. Hem., v, p. 118 (1876).

♀. Entirely ochreous, densely and finely punctured: pronotum with two close longitudinal lines of brown punctures down the middle: coriaceous part of the hemelytra with some more or less distinct, black points on the middle of the disc; membrane brownish, semitransparent, with numerous brown points: wings transparent, nearly colourless: abdomen above, brown at the base and within the lateral margins; margins ochreous, punctured: abdomen beneath, thickly punctured with brown, and with numerous black points; 3-5 segments each with a large whitish patch on each side of the disc: pectus brownish obscure with a large shining castaneous-brown patch on each side of the mesostethium: legs concolorous, femora covered with brown points: rostrum with the tip black: antennæ testaceous, covered with brown points; last joint brown with the base testaceous (*Dallas*). Long, 25 mill.

Reported from India: Sikkim (*mibi*).

Genus *DALSIRA*, Am. & Serv.

Hist. Nat. Ins. Hém., p. 175 (1843); *Phyllocephala*, pt, Dallas, List Hem., i, p. 352, (1851); Walker, Cat. Het., iii, p. 492 (1868). Stål, En. Hem., v, p. 118, 119 (1876).

Head short, almost equally long and broad: antennæ longer than the pronotum: rostrum extending beyond the insertion of the anterior feet: lateral margins of the pronotum rounded, posterior margin truncated, almost straight: scutellum extending a little beyond the middle of the abdomen, sinuated on the sides: membrane almost as large as the coriaceous portion, more or less transparent, with rather regular longitudinal veins: wings a little shorter than the abdomen which is rather a little tumid beneath: feet tolerably robust and short, nearly equal in length (*Am. & Serv.*).

425. *DALSIRA GLANDULOSA*, Wolff.

Edessa glandulosa, Wolff, Ic. Cim., v, p. 176, t. 17, f. 170 (1811).

Aelia glandulosa, Burm., Handb. Ent., ii (i), p. 357 (1835).

Phyllocephala glandulosa, Dallas, List Hem., i, p. 353 (1851); Walker, Cat. Het., iii, p. 492 (1868).

Dalsira glandulosa, Stål, En. Hem., v, p. 119 (1876); Distant, A. M. N. H., (5 s.) iii, p. 45 (1879).

Antennæ 5-jointed, filiform, black, first joint short: head, pronotum, scutellum and hemelytra obscurely ferruginous; head rounded at the apex, impressly punctured, lateral margins somewhat elevated, impressed at the apex with two small lines which diverge posteriorly; ocelli behind the greyish eyes, distant; rostrum 4-jointed, very short, black, placed between two rounded plates at the base: pronotum impressly punctured, convex, posterior angles prominent, somewhat acute: scutellum longer than half the abdomen, impressly punctured and very finely transversely rugose, with a large deep black, marginal gland on each side at the base, transversely rugose, oblong, placed obliquely, posteriorly girth with a somewhat tumid border: hemelytra very finely impressly punctured, with six yellow longitudinal lines alternately abbreviated; membrane fuscous, striated whitish: wings cinerous, veins fuscous: abdomen above fuscous, margin paler, somewhat dentated; beneath brunneous, with a row of elevated points on both sides: pectus concolorous, impressly punctured: anus obtuse: feet unarmed; femora fuscous, with two ferruginous longitudinal lines; tibiæ angulated, ferruginous, exterior side with 4-5 deep black points: tarsi fuscous, 3-jointed (Wolff). Long, 23 mill.

Reported from China, Bengal, Assam (mihi).

Genus *BASICRYPTUS*, Herrich-Schäffer.

Wanz. Ins., VII, p. 81 (1844): Stål, En. Hem., v, p. 119 (1876):—*Phyllocephala*, pt., Dallas, List Hem., i, p. 352 (1851); Walker, Cat. Het., iii, p. 487 (1868).

Dallas included *Phyllocephala*, Lap., *Dalsira*, Am. & Serv., *Schizops*, Spinola, and *Basicryptus*, Herr. Schöff., in his genus *Phyllocephala*. The three last occur in India and near them lies *Gonopsis*: they may be thus differentiated:—

1-6. Pectus without a levigate streak near the coxæ.

2-5. Scutellum without a flavescent, continued streak.

3-4. Costal margin not, unless anteriorly, levigate or sparingly punctate:—*Dalsira*.

4-3. Costal margin of corium entirely pale, levigate and smoothish, sometimes marked by transverse spots or impressions, or by black points arranged in remote transverse rows:—*Basicryptus*.

5-2. Continued lateral streak on scutellum, intramarginal before the middle, marginal behind the middle, also entire costal limbus, flavescens:—*Schizops*.

6-1. Pectus with a levigate lateral streak (posteriorly abbreviated) near the coxæ; the streak generally pale:—*Gonopsis*.

First joint of rostrum is hidden between the oval lateral pieces of the head beneath; second joint free, shortest; 3-4 of equal length; third reaching first coxæ; the fourth reaches the middle of the carinate mesosternum: membrane hardly half the size of the coriaceous portion of the hemelytra.

Genus BASICRYPTUS, Herr. Schöff.

Wanz. Ins., vii, p. 83 (1844): Stål, En. Hem., v, p. 119 (1876).

Juga rounded at the apex, contiguous beyond the tylus; first joint of rostrum entirely hidden, second shortest, 3-4 equally long, third reaches the first pair of feet, fourth the middle of the finely ridged mesostethium: membrane half as large as the coriaceous portion.

426. BASICRYPTUS ILLUMINATUS, Distant.

Basicryptus illuminatus, Dist., Trans. Ent. Soc., p. 358 (1887).

Body above dull dark reddish, pronotum with a broad, discal, transverse, luteous band, margined black, attenuated at each end, and slightly notched at the middle: eyes dull ochraceous; 1-3 joints of antennæ reddish: lateral margins of the pronotum somewhat finely crenulated, the lateral angles broadly and subacutely produced: scutellum with a small luteous spot in each basal angle and a few very small luteous spots at the apex, and with some median and lateral black punctures: base of lateral margin of corium narrowly luteous, and with some very small and irregular scattered black spots: membrane pale hyaline, somewhat thickly ornamented with small fuscous spots: body beneath and legs dull reddish, with black punctures: disc of sternum and some sublateral streaks to abdomen obscure luteous: tarsal joint somewhat ochraceous beneath (*Dist.*). Long, 14; exp. angl. pron., 10 mill.

Reported from N. India.

Genus SCHIZOPS, Spinola.

Schizops, Ess., p. 297 (1837): *Schizops*, Am. & Serv., Hist. Nat. Ins. Hém., p. 176 (1843); Stål, pt., Hem. Afric., i, p. 234, 239 (1864); En. Hem., v, p. 118, 120 (1876).

Head triangular, juga produced much beyond the tylus and forming the apex of the triangle, rounded, bifid, the cleft very narrow, contracted

hindwards and reduced near the end of the tylus to a simple impression where about two other like impressions that mark the separation of the three lobes: labrum and rostral canal start from the end of the tylus, the former is transversely striated and covers the whole of the first and at least half the second joint of the rostrum: head beneath convex; the rostral canal does not reach its base and receives the whole of the first joint of the pronotum and part of the second joint; the rostrum does not reach the mesostethium, the apex of its fourth joint rests on the posterior margin of the prostethium between the first pair of feet; there is no ventral groove: prostethium flat, acuminate, its sides with a simple margin: mesostethium flat, apex tumid, concealing the middle of the first segment: the second segment without spine or protuberance, venter uniformly convex and even somewhat tumid: femora simple; tibiæ triangular, edges not dilated; first joint of tarsi as long as the other two together: abdomen extending beyond the hemelytra: membrane occupying one-third of the hemelytra, veins variable.

Differs from *Dalsira*, Am. & Serv., in having the lateral streak continued through the scutellum, intramarginal before the middle, marginal behind the middle, also costal limbus, entirely flavescent.

427. SCHIZOPS INSIGNIS, Walker.

Schismatops insignis, Walker, Cat. Het. iii, p. 495 (1868).

Schizops insignis, Stål, En. Hem., v, p. 120 (1876).

Tawny, very thickly and minutely punctured, slightly clouded with blackish beneath: head a little longer than its breadth; juga lanceolate, contiguous, except at their tips: eyes livid, not prominent: rostrum extending to the first coxæ: antennæ black; second joint a little longer than the third: pronotum between the hind angles with a transverse ridge and an anterior slight metallic-green transverse furrow, the latter abbreviated at each end; space between the ridge and the hind border mostly piceous; hind angles acute, prominent: scutellum piceous, rounded at the tip, with two testaceous stripes which are bordered with bright green on the outer side near the base: legs tawny: hemelytra piceous; costa testaceous; membrane cinereous with many black points (*Walker*). Body long, 17-18 mill.

Reported from Burma.

Genus GONOPSIS, Amyot & Serville.

Hist. Nat. Ins. Hem., p. 180 (1843); Stål, En. Hem., v, p. 121 (1876).

Allied to *Megarhynchus*, Lap.: head with the juga distant: posterior angles of pronotum very prominent in a pointed spine: extremity of ab-

domen, in ♂, almost straightly truncate; in ♀, slightly roundly emarginate (*Am. & Serv.*).

428. GONOPSIS RUBESCENS, Distant.

Gonopsis rubescens, Dist., Trans. Ent. Soc., p. 359 (1887).

Body above sanguineous: head somewhat obscurely punctate; antennæ reddish, third joint shorter than second or fourth, fifth joint longest and pilose: lateral margins of the pronotum finely crenulate, the lateral angles produced into short subacute spines between which is a transverse ridge, before which the surface is obliquely deflected towards the head; pronotum is also transversely rugulose, except two levigate spots on the anterior area: scutellum longitudinally rugose, with a row of black punctures on the basal half of the lateral margins: corium obscurely punctate and finely rugulose, with a few black punctures near the inner apical angle: membrane pale hyaline: body beneath and legs pale reddish; the body is very finely and darkly punctate, and the tibiæ have a fuscous spot on under side of apices (*Dist.*). Long, 14; exp. angl. pron., 7 mill.

Reported from Sikkim.

Genus DIPLORHINUS, Am. & Serv.

Hist. Nat. Ins. Hém., p. 178 (1843); Dallas, *List. Hem.*, i, p. 359 (1851); Walker *Cat. Het.*, iii, p. 494 (1868); Stål, *En. Hem.*, v, p. 118, 122 (1876).

Juga prolonged, broad, divaricate, pointed: 2-3 joints of the antennæ of equal length: pronotum posteriorly rugose and strongly punctured, lateral angles produced in a process which is obtuse or abruptly somewhat acuminate at the apex, turning outwards, sides crenulate: scutellum less strongly punctured than the pronotum: veins of membrane, straight, black on a pale ground: posterior tibiæ straight.

429. DIPLORHINUS QUADRICORNIS, Stål.

Diplorhinus quadricornis, Stål, *En. Hem.*, v, p. 122 (1876).

♂. Very close to *D. furcatus*, Westw., differs in the longer juga, gradually acuminate, more divaricate, furnished with straight lateral margins; pronotum more strongly rugose, lateral margins more remotely and more obtusely denticulate, process of the lateral angles twice as long, body narrower (*Stål*). Long, 20; broad, $8\frac{1}{2}$; breadth of pronotal processes, $12\frac{1}{4}$ mill.

Reported from N. E. India, Assam (mihi).

430. *DIPLORHINUS FURCATUS*, Westwood.

Atelocerus ? *furcatus*, Westwood, Cat. Hem., i, p. 20 (1837).

Phyllocephala distans, Herr. Schöff., Wanz. Ins., vii, p. 71, t. 237, f. 740 (1844).

Orthoschisops ? *furcata*, Walker, Cat. Het., i, p. 232 (1867).

Diplorhinus furcatus, Am. & Serv., Hist. Nat. Ins. Hém., p. 178, t. 3, f. 6 (1843); Dallas, List Hem., i, p. 359 (1851); Walker, l. c. iii, p. 494 (1868): Voll., Faune Ent. l'Arch. Ind. Néerl., iii, p. 41 (1868): Stål, En. Hem., v, p. 122 (1876).

Fuscous: hemelytra and scutellum a little paler: head large, porrect, bifurcate: antennæ short, very slender, pale: pronotum scabrous, sides serrate and posteriorly produced on both sides in a prominent angle: median line on hemelytra, blackish: membrane hyaline, with eight straight, black, longitudinal veins: feet lutescent (*Westw.*). In *P. distans*, H. S., the lateral margin of the hemelytra and a small longitudinal line at base of the scutellum are ochreous; beneath dark brown, more red-brown posteriorly: feet yellow-brown. Long, 18-19 mill.

Reported from Java. Sumatra.

Genus *MACRINA*, Amyot & Serville.

Hist. Nat. Ins. Hém., p. 179 (1843): pt., Dallas, List Hem., i, p. 360 (1851); Walker, Cat. Het., iii, p. 496 (1868): Stål, Hem. Afric., i, p. 234, 244 (1864); En. Hem., v, p. 118, 122 (1876).

Body oblong-ovate: head triangular; juga flat, very acute, contiguous or somewhat so; in Indian species, the second joint of the antennæ extends at least by half beyond the apex of the head: sides of pronotum produced behind the middle in a gradually acuminate process, turning outwards and more or less forwards: posterior angles of the genitalia, in ♂, hardly prominulous, rounded.

431. *MACRINA DILATATA*, Distant.

Macrina dilatata, Distant, A. M. N. H., (5 s.) iii, p. 45, 52 (1879): Waterhouse, Aid, t. 6.

Broad, ovate: head broad, triangular, moderately covered with deep dark punctures; juga slightly sinuated, divided at the apex, meeting beyond the tylus which is much shorter: antennæ with the third joint shortest; fourth rather longer; fifth longest, black, with the base rufous (the first four joints vary in different specimens from rufous to luteous): rostrum reaching anterior coxæ: pronotum with the base slightly rugulose, somewhat crescent-shaped in front where it is bordered with a pale luteous band between the lateral angles, which are produced into two stout spines directed forwards; spinal apices black: anterior portion of the pronotum abruptly deflexed to the head, transversely costate, mo-

derately punctured with brown; lateral borders denticulated: scutellum reaching beyond the base of the membrane, with five longitudinal, indistinct, somewhat catenulate elevated ridges, which are sprinkled with luteous, the median ridge generally most indistinct: membrane pale fuscous, extending beyond the apex of the abdomen: beneath and legs concolorous, thickly and finely punctured with brown: tibiæ sulcated (*Distant*). ♂, long 16, breadth at base of corium 8; exp. angles pronot. 11 millims. ♀, long 17, breadth at base of corium, $8\frac{1}{2}$, exp. angles pronot. 12 mill.

This species approaches *M. coccinea*, Walker, but differs in its much greater breadth: some specimens are of a much darker colour than others.

Reported from the Naga hills 2000-6000 feet; N. Khasiya hills 1500-3000 feet.

432. *MACRINA COCCINEA*, Walker.

Macrina coccinea, Walker, Cat. Het., iii, p. 497 (1876); *Distant*, A. M. N. H., (5 s.), iii, p. 45 (1879).

Bright red, very elongate-oval; head acute, a little longer than broad; tylus transversely striated; juga contiguous, obliquely striated: eyes not prominent: rostrum partly black, extending to the first coxæ: antennæ slender; second joint much longer than the third, as long as the fourth; fifth longer than the fourth, sometimes mostly black: pronotum and scutellum transversely rugulose; the former with a ridge between the posterior angles, which are acute, elongated and slightly inclined forward; sides in front serrated; a transverse, sometimes testaceous, callus on each side near the anterior margins: scutellum much attenuated, rounded at the tip, with a few or many yellow speckles: abdomen truncated at the tip; legs slender: hemelytra thickly and minutely punctured; membrane pellucid (*Walker*). Body long, $14\frac{1}{2}$ -15 mill.

Reported from Penang, India, Assam, Sikkim (mihi).

Genus *TETRODA*, Am. & Serv.

Hist. Nat. Ins. Hém., p. 177 (1843); Dallas, List Hem., i, p. 355 (1851); Walker, Cat. Het., iii, p. 493 (1868); Stål, Hem. Afric., i, p. 234 (1864); En. Hem., v., p. 118, 122 (1876).

Head with the juga long, gradually acuminate, slightly diverging outwards, somewhat straight, and tip slightly rounded; narrowed from the eyes, not incised at the eyes, lateral margins for the most part straight: second joint of antennæ a little shorter than the third, rest

almost equal in length: sides of pronotum laminated, produced anteriorly in a depressed porrect process, sides scarcely crenulate: scutellum extending scarcely beyond the middle of the abdomen, ending in a rounded point: veins of membrane rather straight.

433. TETRODES HISTEROIDES, Fabricius.

Acanthia histeroides, Fabr., Ent. Syst. Suppt. p. 526 (1798).

Aelia furcata, Fabr., Syst. Rhyng., p. 188 (1803): Stoll, Punaies, p. 109, t. 28, f. 197 (1788).

Aelia histeroides, Fabr., Syst. Rhyng., p. 189 (1803).

Phyllocephala furcata, Herr. Schöff., Wanz. Ins., vii, p. 70, t. 237, f. 738 (1844).

Megarhynchus 4-spinosus, Westw., Hope, Cat. Hem., i, p. 19 (1837); Walker, l. c. p. 493 (1868)?

Tetroda histeroides, var. *sumatrana*, Ellenr. Nat. Tijds. v. Ned. Ind., xxiv, p. 171 (1862).

Tetroda histeroides, Am. & Serv., Hist. Nat. Ins. Hém., p. 178 (1843); Dallas, List Hem., i, p. 356 (1851); Walker, Cat. Het., iii, p. 493 (1868); Stål, Hem. Fabr., i, p. 41 (1868); En. Hem., v, p. 122 (1876); Vollenhoven, Faune Ent. l'Arch. Indo-Néer., iii, p. 41 (1868); Distant, A. M. N. H., (5 s.), iii, p. 45 (1879); Scott, Trans. Ent. Soc., p. 306 (1880).

Head black, bifid, with the rostrum inserted below the lobes; pronotum obscure, flat, the anterior angle much produced on both sides, somewhat spinose: scutellum black with a white marginal line on both sides: hemelytra black: body obscure (*Fabr.*). Long, 17 mill.

Reported from Java, Burma, Bengal, Sikkim (mihi), Assam (mihi), Sinkip island.

434. TETRODA DIVARICATA, Dallas.

Tetroda divaricata, Dallas, List Hem., i, p. 356 (1851); Walker, Cat. Het., iii, p. 493 (1868); Stål, En. Hem., v, p. 124 (1876).

♂. Fuscous, punctured: juga divaricate: membrane whitish, veins black: body beneath more obscure: antennæ black, two basal joints fuscous (*Dallas*). Long, 13-14 mill. Hardly different from *T. histeroides*, Fabr.

Reported from Nepál, Sikkim (mihi).

435. *Tetroda atomaria*, Dallas, List Hem., i, p. 356 (1851); Walker, Cat. Het., iii, p. 493 (1868).

♂. Head testaceous, thickly and faintly punctured; juga nearly meeting at the apex, lateral margins straight: pronotum with the anterior portion testaceous, obscure, punctured, becoming dark brown posteriorly, with numerous small elevated testaceous points: scutellum

dark brown, nearly black, punctured, with numerous small warts similar to those on the pronotum, and on each side at the base a yellow impunctate line, which tapers to a point posteriorly: coriaceous portion of the hemelytra dark brown, punctured, with several irregular longitudinal testaceous lines formed of small raised points; membrane whitish, opaque: body beneath testaceous, with an interrupted black band down each side within the lateral margins, on the line of the stigmata; stigmata white: pectus punctured with brown: legs testaceous; femora punctured with brown: rostrum pale testaceous: antennæ yellowish-white (*Dallas*). Long, $12\frac{1}{2}$ mill.

Reported from N. India.

436. *TETRODA BILINEATA*, Walker.

Tetroda bilineata, Walker, Cat. Het., iii, p. 494 (1868).

Fawn-colour or blackish, or of an intermediate hue, very thickly and minutely punctured: head very much longer than broad; jugæ separate, lanceolate, twice the length of the tylus: eyes rather prominent: rostrum extending to the first coxæ: antennæ black, about one third the length of the body; second joint a little longer than the third; fourth longer than the second; fifth a little longer than the fourth: pronotum and scutellum transversely and slightly striated: pronotum with the anterior angles porrect, much elongated, very acute: scutellum attenuated rounded at the tip, with two whitish stripes which taper and converge from the base nearly to the tip and are bordered with black on the outer side: abdomen beneath in the blackish individuals of a dull dark red hue: membrane cinereous; veins black (*Walker*). Body long, 14-17 mill.

Reported from Java, Sumatra, Malacca, Burma, India, Sikkim (mihi).

GENUS *GELLIA*, Stål.

Hem. Afric., i, p. 234, 243 (1864); En. Hem., v, p. 118, 122 (1876).

Body oval: head much dilated, foliaceous, lateral margins distinctly incised at the eyes, abruptly dilated at the eyes and forming an angle, thence rounded before the incisure; jugæ very slightly distant: anterior lateral margins of the pronotum produced forwards in a depressed lobe.

437. *GELLIA NIGRIPENNIS*, Dallas.

Tetroda nigripennis, Dallas, List Hem., i, p. 357 (1851); Walker, Cat. Het., iii, p. 493 (1868).

Gellia nigripennis, Stål, En. Hem., v, p. 123 (1876).

♂. Reddish-testaceous, thickly and finely punctured: head with

the lateral margins abruptly dilated a little before the eyes; juga foliaceous, rounded externally and nearly meeting at the apex: pronotum faintly rugose transversely, and with a distinct transverse ridge not far from the posterior margin: scutellum with its lateral margins brownish and with a black streak at each side at the base: hemelytra with the disc brownish; membrane black: margins of the abdomen ferruginous: body beneath with an irregular blackish band on each side on the line of the stigmata which are white: legs testaceous; tibiæ at the apex and the tarsi ferruginous: rostrum and antennæ testaceous, the latter somewhat ferruginous (*Dallas*). Long, $12\frac{1}{2}$ -13 mill.

Reported from N. India, Karachi (mihi).

438. GELLIA OBTUSA, Dallas.

Tetroda obtusa, Dallas, List Hem., i, p. 357 (1851); Walker, Cat. Het., iii, p. 493 (1868).

Gellia (?) *obtusa*, Stål, En. Hem., v, p. 124 (1876).

♂. Testaceous, very thickly and finely punctured: head with the juga foliaceous, rounded at the apex, with the inner angles obtuse, not meeting; lateral margins with a minute black spine, tipped with yellow, on each side in front of the eyes: pronotum with an indistinct, transverse ridge near the hinder margin: scutellum with several scattered black points, and a black streak on each side at the base: membrane whitish, opaque: abdomen beneath thickly and rather coarsely punctured, with a large transverse impunctate pit on each side of each segment, touching the posterior margin of the preceding segment; the space around each of the stigmata with an irregular patch of black punctures: pectus rather coarsely punctured, with a few scattered black points, and a black shining spot on each side of the metastethium: legs testaceous; femora with brown points: rostrum testaceous, with the apex black: antennæ testaceous (*Dallas*). Long, $13\frac{1}{2}$ -14 mill.

Reported from N. India.

Genus MEGARHYNCHUS, Lap.

Ess. Hém., p. 65 (1832): Am. & Serv., Hist. Nat. Ins. Hém., p. 179 (1843): Dallas, List Hem., i, p. 361 (1851): Walker, Cat. Het., iii, p. 498 (1868): Stål, Hem. Afric., i, p. 234 (1864); En. Hem., v, p. 118, 123 (1876).

Body very elongate: head very long, ending in a sharp, bifid point, the bifurcation so close as to appear above but a longitudinal groove in the middle of the head: eyes very small, hardly prominulous: antennæ long, 5-jointed, first very short, rest of equal length to each other: rostrum very short, hardly reaching the insertion of the first pair of feet,

joints rather equal: pronotum nearly continuing the triangle formed by the head, without posterior spines turning forwards; posterior angles not prominulous: scutellum elongate, rounded at the tip, extending a little beyond the half of the abdomen: hemelytra hardly allowing the margin of the abdomen to be seen; membrane shorter than the coriaceous portion: wings shorter than the hemelytra: abdomen flat above, slightly tumid beneath, elongate, as broad at its base as the pronotum, gradually narrowing and abruptly truncate at the tip, nearly at the end of the hemelytra: feet robust, long, unarmed; tarsi long (*Am. & Serv.*).

439. MEGARHYNCHUS ROSTRATUS, Fabricius.

Aelia rostrata, Fabr., Syst. Rhynch., p. 188 (1803): Burm., Handb. Ent. ii (i), p. 357 (1835).

Lygæus hastatus, Fabr., Syst. Rhynch., p. 239 (1803).

Megarhynchus elongatus, Laporte, Ess. Hém., p. 65 (1832).

Megarhynchus hastatus, Dallas, List Hom., i, p. 361 (1851); Walker, Cat. Hem., iii, p. 498 (1868): Voll., Faune Ent. Ind. Néer., iii, p. 42 (1868).

Megarhynchus rostratus, Am. & Serv., Hist. Nat. Ins. Hém., p. 180 (1843): Herr. Schöff., Wanz. Ins., ix, p. 303, t. 322, f. 999 (1853): Ellendr., Nat. Tijdschr. Ned. Ind., xxiv, p. 172, f. 31 (1862); Stål, Hem. Fabr., i, p. 41 (1868); Ofvers. K. V.-A. Förh., p. 645 (1870); En. Hem., v, p. 123 (1876).

Clypeus of the head very long, bifid, with acute lobes; head, pronotum, hemelytra, body and feet, cinereous, immaculate; antennæ alone entirely rufous (*Æ. rostrata*, Fabr.). Very elongate: head porrect, subulate, acute, sulcate in the middle: antennæ inserted beneath the head, pale at the base, rufous at the apex: pronotum smooth, a little produced on both sides posteriorly, pale deep black before the margin: the margin itself white: scutellum elongate, smooth, flavescent; margin white: hemelytra ferruginous, margin white: wings hyaline: body flavescent, with a deep black spot on both sides at the apex (*L. hastatus*, Fabr.). Long, 20 mill.

Reported from Philippines, Java, Sumatra, Cambodia, Cochin-China, Siam, Burma, India, China, Sikkim (mibi).

440. MEGARHYNCHUS TRUNCATUS, Westwood.

Megarhynchus truncatus, West., Hope, Cat. Hem., i, p. 20 (1837); Dallas, List Hem., i, p. 361 (1853): Walker, Cat. Hem., iii, p. 498 (1868): Voll., Faune l'Arch. Ind. Néer., iii, p. 43 (1868): Stål, En. Hem., v, p. 123 (1876).

Megarhynchus testaceus, Am. & Serv., Hist. Nat. Ins. Hém., p. 180 (1843): Walker, l. c., iii, p. 498 (1868).

Large: sub-parallel, testaceous-luteous, punctured fuscous: head acuminate, scarcely bifid, pronotum simple, as broad as the abdomen,

sides oblique, serrated: hemelytra fuscous, marked with pale lines: apex of the abdomen truncated (*Westw.*). Form somewhat similar to the broader examples of *M. rostratus*, Fabr., head and pronotum punctured fuscous; anterior lateral margins of the pronotum narrowly pallescent, not so strongly transversely rugose; distinct median longitudinal line and fine anterior transverse wrinkle levigate; posterior angles produced in an acuminate tooth (*Stål*). Long, 21 mill.

Reported from Java, Penang, India, China, Assam (mihi).

441. *MEGARHYNCHUS LIMATUS*, Herr. Schöff.

Megarhynchus limatus, Herr. Schöff., Wanz. Ins., ix, p. 303, t. 322, f. 998 (1853): *Stål*, En. Hem., v, p. 124 (1876): Distant, A. M. N. H., (5 s.), iii, p. 45 (1879).

Elongate-obovate, broadest over the pronotum: head bifid, a little longer than broad: pronotum and scutellum grossly punctured, transversely rugose: sides of pronotum serrulate, roundly prominulous and moderately acute, though the angles are hardly prominent: scutellum with five weakly elevated longitudinal lines: the hemelytra finely punctured between the elevated veins: dark ochreous yellow; the feet more ferruginous; hemelytra between the veins, purple-red. Like and closely allied to *M. truncatus*, *Westw.*, from which it differs in having head and pronotum shorter, stature broader, punctuation stronger, concolorous or weakly ferruginous, rarely fuscous on the head: the lateral margins of the pronotum are not pallescent, they are strongly rugose, posterior angles slightly and somewhat obtusely prominulous, no levigate longitudinal line or only a very obsolete one, no anterior transverse wrinkle or ridge. Long, 20-21 mill.

Reported from Assam (mihi).

442. *MEGARHYNCHUS TRANSVERSALIS*, Westwood.

Tetroda transversalis, *Westw.* in Royle's Ill. Bot. Him., p. liv, t. 10, f. 7 (1839): Dallas, List Hem., i, p. 356 (1861); Walker, Cat. Het., iii, p. 493 (1868).

Megarhynchus (?) *transversalis*, *Stål*, En. Hem., v, p. 124 (1876).

Fuscous-black: acutely bicornuted; anterior angles of pronotum produced acutely forwards: pronotum and scutellum transversely striated: corium black, very thinly punctured; membrane whitish: antennæ and feet black (*Westw.*). Long, $15\frac{1}{2}$; broad, $7\frac{1}{4}$ mill.

Reported from the Himalaya.


443. *MEGARHYNCHUS DIVERSUS*, Walker.

Megarhynchus diversus, Walker, Cat. Het., iii, p. 498 (1868).

Testaceous, subfusiform, narrowest at the tip of the abdomen, thick-

ly and minutely punctured; some of the punctures black: head a little longer than broad; juga lanceolate, connected: eyes not at all prominent: rostrum extending to the fore coxæ: antennæ slender, second joint much longer than the third, as long as the fourth; fifth longer than the fourth: pronotum with the posterior angles prominent and nearly rectangular; sides in front serrated: scutellum attenuated, rounded at the tip, with some black speckles along each side near the base: abdomen with the hind angles of the apical segment extending beyond the anal appendage: hemelytra more minutely punctured than the pronotum: membrane pellucid (*Walker*). Long, $12\frac{1}{2}$ mill.

Reported from India. Differs from *M. truncatus*, Westw., in having the posterior angles of the pronotum more determinate and the thorax more abruptly contracted.



IV.—On certain Earthworms from the Western Himalayas and Dehra Dun.—By ALFRED GIBBS BOURNE, D.Sc. (Lond.), C.M.Z.S., F.L.S., Fellow of University College, London, and Madras University. Communicated by THE SUPERINTENDENT OF THE INDIAN MUSEUM.

[Received December 15th, 1888 ;—Read January 2nd, 1889.]

(With Plate III.)

Introduction.—These specimens were collected and placed in my hands for examination by Mr. J. Wood-Mason, Superintendent of the Indian Museum, Calcutta. They come from two localities, Dehra Dun and Masouri. Dehra Dun lies at the foot of the Western Himalayas and at no great elevation. Masouri lies at an elevation of 5—6000 feet on the southern slopes of the Western Himalayas.

The worms from Dehra Dun belong to the three genera *Perichæta*, *Perionyx*, and *Typhæus*. There is one species of each of these genera. The *Perichæta* is *P. houlletii*, E. Perrier. The specimens of *Perionyx* are none of them in a sufficiently mature condition to enable me to characterize the species; they differ in the shape of the setæ and in colour from *P. saltans*, Bourne; neither can they be referred to *P. excavatus*, E. Perrier; nor to *P. m'intoshii*, Beddard. The *Typhæus* I have referred to a new species, *T. masoni*. The worms from Masouri include three species of *Lumbricus*, or at any rate of some genus or genera of the *Lumbricidæ*, and two species of *Perionyx*. The specimens of the latter are, like the specimens of *Perionyx* from Dehra Dun, immature, and do not moreover appear to belong to any of the hitherto described species of this genus. I refrain from naming the species of *Lumbricus*, because I could only give an incomplete description and thus hamper any future observer who obtains them in a fresh condition. The literature with regard to the genera and species of the *Lumbricidæ* is already in great confusion. I am now acquainted with seven distinct species belonging to this family which occur in India.

We have not at present many data with respect to the relation between the altitude and the worm fauna.

I have stated* that *Perichæta stuarti* is to be found at an elevation, of 5000 ft. and also at one of 1000 ft., but this has proved to be a mistake which arose from my collector having mixed specimens from the two localities. I cannot find *P. stuarti* at any great distance down the ghaut.

* On Indian Earthworms, Part I. Preliminary Notice of Earthworms from the Nilgiris and Shevaroyes. Proc. Zool. Soc. 1886, p. 667.

Fletcher* has recorded specimens of the same species of worm from different altitudes, e. g., *Lumbricus novæ-hollandiæ* from the sea-level at Sydney and from 2,700 ft. at Capertee; *Perichæta exigua* from the sea-level near Sydney and from Springwood on the Blue Mountains.

There is, I presume, nothing like the difference in climate between these Australian localities that exists between that of any hill-station in India and of the plains. So far as my observations go all the species from hill-stations differ from those of the plains. I have found species of *Perichæta*, *Acanthodrilus*, and *Moniligaster* on the hills and other species in the plains, but I have never found *Lumbricus* in the plains. I do not know how far the present collection is an exhaustive one from the district, but so far it appears that *Typhæus* is confined to the plains or moderate elevations, while there is an undoubted *Perionyx* from Dehra Dun, and of the three species of *Perionyx* previously described *P. saltans* comes only from considerable elevations, *P. excavatus* and *P. m'intoshi* come presumably from the plains, so that the genus *Perionyx* is also to be found at varying elevations.

None of the species in the present collection are identical with any which I have hitherto found in Southern India.

PERICHÆTA HOULLETI.

I do not propose to give any lengthy account of this worm without examining it in a fresh state. It is the less necessary to do so as the existing accounts enable one to recognise it with great certainty. It was originally described by Perrier,† and Beddard subsequently published two notes upon the species.

In one‡ of these he has described the setæ which are placed on the clitellar somites as much smaller than the setæ of the "anterior pre-clitellar" somites, and states that they terminate in a "distinctly bifid extremity; the two points in which the seta ends diverge at a considerable angle from each other, but are connected by a delicate membrane. The opposite extremity of the seta, which is imbedded in the body wall, is abruptly truncated. The whole seta has not the S-shaped curve, which is so constant a character in the group, but is curved only in one direction. As in the other setæ of the same species, and in the setæ of earthworms generally, the middle part is somewhat thicker; but this region does not lie in the middle of the

* Notes on Australian Earthworms. Proc. Linn. Soc. N. S. W. 1886, p. 545; 1887, p. 387.

† E. Perrier, Recherches pour servir à l'Histoire des Lombriciens Terrestres, Nouv. Arch. d. Mus. t. viii, 1872.

‡ Proc. Zool. Soc. 1887, p. 389.

setæ, but is closely approximated to the posterior extremity; the part of the seta which lies behind the dilated region is straight. The general shape of these clitellar setæ, apart, of course, from the bifid extremity, is like that of imperfectly developed ordinary setæ. That this is not really the case with these setæ is, however, clearly shown by the fact that all the setæ of the several rows comprised in the clitellum have precisely the same shape, and also by the fact that in two specimens of the worm, which were the first that came to hand, the structure of these clitellar setæ was precisely identical."

The ordinary setæ present also some variations in size. The seta immediately on either side of the median ventral line is usually if not always larger than the others. The setæ on the clitellar somites in my specimens agree with the minute description quoted above.

Perrier states that the gizzard occupies somite IX, but I have found that the septa separating somites VIII—IX and IX—X are absent, so that the gizzard may be said to occupy somites VIII, IX, X. This is the position ascribed to the gizzard in *P. fecæ*, *P. indica*, *P. peregrina*, and is moreover its probable position in *P. sieboldi*, *P. japonica*, *P. musica*, and *P. annulata*. These are all worms possessing other special characters in common, and further investigation will probably add to the list *P. affinis*, *P. birmanica*, *P. sumatrana*, *P. hasselti*, *P. robusta*, *P. aspergillum*, *P. quadragenaria*, *P. elongata*, *P. schmardæ*, *P. capensis*, and, possibly, *P. qucenlandica* and *P. darnleiensis*.

The organs described by Perrier as testes are doubtless seminal reservoirs; in position and structure they agree with these organs in so many other worms. I have not, however, been able to find the true testes, but could doubtless do so in fresh specimens. The spermathecæ and prostates have been described and figured by Perrier. I have figured them in Pl. III, Figs. 4 and 5. The number, position, and structure of the spermathecæ have been largely used as specific characters. The structure of the prostate glands is a character of no less specific importance.

TYPHÆUS MASONI, sp. n.

External characters.—Length 130 m.m.; width 6 m.m. Prostomium is short and broad and can be retracted so as to be hidden by the first or buccal somite. The latter is but very slightly marked off from the second somite and is as usual devoid of setæ. The other pre-clitellar somites consist of two, three, or even four annuli.

The clitellum when fully developed extends completely round the body in somites XIV, XV, XVI, nearly the whole of XVII, and a small portion of XIII.

The clitellum presents ventrally a very curious appearance owing to the structures about to be described. Between somites XV and XVI, and also between somites XVI and XVII, there is a pair of oval depressions in the middle of each of which stands a little papilla. Between somites XIX and XX there are similar structures, but the depressions are much less marked and the whole thing is smaller. These structures are a very little further from the ventral median line than are the ventral pair of setæ on each side. The male pores are placed in somite XVII a little further still from the median ventral line; they are on papillæ which lie in very deep pits. These structures are shewn in Pl. III, Fig. 1.

The oviducal pores are placed anteriorly to the setæ in somite XIV; they are separated from one another.

The spermathecal pores are very well marked slit-like apertures placed between somites VII and VIII; they lie nearer the middle line than do setæ 3.* The dorsal pores, intersomitaly placed, are visible behind the clitellum; they are especially well marked at the posterior end of the body.

Nephridiopores are not visible. There are eight setæ in each somite; they are confined to the ventral surface of the body. Their arrangement in eight longitudinal rows is what chiefly strikes one on examining a spirit specimen. In about the anterior two-thirds of the body setæ 1 and 2, and 3 and 4, lie nearer to one another than do setæ 2 and 3, that is to say, the setæ are placed in couples, but this arrangement gradually changes and in about the posterior third of the body the eight setæ still lying in a row on the ventral surface are almost equidistant from one another. The ventral gap remains however a trifle wider than the interspace between any two setæ.

The full complement of setæ is present in the clitellum, but in somite XVII setæ 1 and 2 are replaced by the groups of penial setæ described below.

Septa.—The most anterior septum is septum IV—V (*i. e.*, the septum which forms the boundary between somite IV and somite V). This and septum V—VI are very thick being exceedingly muscular. The next septa which are developed are, I think, septa VIII—IX, IX—X, and X—XI. These are all fairly muscular and placed close together, that is to say, they do not correspond in position with the external divisions between the somites. It is therefore exceedingly difficult to

* I adopt the convenient system of numbering the setæ suggested by Benham, seta 1 being the seta which lies nearest the median ventral line on either side; seta 2 the seta immediately beyond seta 1 and so on.

state with certainty which segments they really bound. All the remaining septa are very thin.

Alimentary Canal.—The mouth occupies the usual position and when the prostomium is protruded is overhung by it, but, as stated above, the prostomium can be retracted so as to be completely hidden by the buccal somite; the mouth then appears to be terminal.

The buccal cavity and pharynx resemble those of *T. orientalis*.

The gizzard has precisely the structure described for that species. It is "divided into two portions an anterior small thin-walled compartment and a large thick-walled portion, the gizzard proper, this last has a nacreous appearance on the outside and is lined by a very thick chitinous layer." It lies between septum V—VI and septum VIII—IX and thus extends over three somites (VI, VII, VIII). Muscular bands are attached to the walls of the gizzard and pass to the body wall.

The alimentary canal is considerably dilated in somite XI or XII, a pair of oesophageal glands being present. From the gizzard up to this dilation the oesophagus is narrow, and beyond the latter, until it widens out at about somite XVI, it is also narrow.

There are four pairs of glandular bodies placed on the intestine in the hinder region of the body. They are all bi-lobed and lie below the dorsal vessel and not above it. (Beddard states that they lie above the dorsal vessel in *T. orientalis*.)

Nephridia.—There are large tufts of nephridial tubules in the pharyngeal region and a series of smaller tufts in the other pre-clitellar somites. I have especially noted the tufts which are placed near the spermathecal ducts. I am unable, from the specimens I have, to enter into further details with regard to the nephridia, but I have observed nothing which differs from Beddard's account of these organs in *T. orientalis* and *T. gammi*.

Generative organs.—I am anxious to examine other specimens before giving a full account of these organs.

A pair of ovaries are present in the usual position in, I believe, somite XIII, but the specimens being very contracted in this region it is impossible to be quite certain as to the number of any particular somite. The oviducts open to the exterior by a pair of pores placed in the anterior half of somite XIV.

I have been unable to see the testes.

I have found a single pair only of seminal reservoirs and near them a pair of bodies with a nacreous appearance which seem to be ciliated rosettes, as, connected with these, I find the vasa deferentia.

I cannot be quite certain, but apparently both the seminal reservoirs and the ciliated rosettes belong to somite XI; as mentioned above, the

septum which I have calculated to be septum X—XI is a thick one, and they certainly lie posterior to it. The seminal reservoirs are very large and extend backwards over three or four somites.

The prostates (I reserve for the present any expression of opinion as to the desirability of retaining this term or substituting for it the term atria) are large and lie one on either side of the body. Each consists of an irregularly coiled, almost orange-coloured, glandular tube which is connected at one end with a muscular duct opening to the exterior in somite XVII. The vas deferens is connected with this just before it penetrates the body wall. There is a muscular sac containing several very long and slender penial setæ; these project from the little papilla which lies in the depression round the male pore. These setæ are shewn in Pl. III, Fig. 3. There are two varieties, one of which is nearly a quarter of an inch in length and much longer than the other.

There is a single pair of spermathecae, the apertures of which lie between somites VII and VIII, as shown in Pl. II, Fig. 1. Each spermatheca is large, somewhat reniform in shape, and has arising from the hilus a short, very stout and muscular efferent duct. Opening into the duct near the hilus is a pair of diverticula. One of these is so deeply bi-lobed as to almost form two separate little sacs, while the other is slightly tri-lobed. Both have a very nacreous appearance which is not possessed by the spermatheca itself.

General Remarks.—There can be no doubt but that this worm belongs to the genus *Typhæus*, Beddard. Two species of this genus have been described, *T. orientalis** and *T. gammi*.†

I should have hesitated about placing this worm without further information in a separate species had not Beddard described this second species *T. gammi*; but this worm differs as much from either *T. orientalis* or *T. gammi* as these latter do from one another. Beddard denies the existence of a prostomium. If this is non-existent it is a very remarkable fact. Beddard states that setæ 3 and 4 are absent from the somites which form the clitellum in *T. orientalis*. He does not mention their presence or absence in speaking of *T. gammi*. They are present in my species, although not always visible on a mere external examination. Beddard says nothing with regard to the arrangement of the setæ in the posterior region of the body, so that I am justified in concluding that the arrangement which I have noted is peculiar to my species; it gives the worm such a striking appearance that one could hardly fail to notice it. Beddard does not mention œsophageal glands as present in either *T. orientalis* or *T. gammi*.

* Beddard, Ann. & Mag. Nat. Hist. ser. 4, vol. xii, 1889.

† Beddard, Quarterly Journ. Microsc. Science, vol. xxix, 1888.

There is still some doubt, I think, with regard to the position of the septa in all species, and, until this is resolved, it is difficult to fix the position of the testes, seminal reservoirs, and ciliated rosettes. Beddard states that in *T. gammi* the two most anterior septa are septa IV—V and V—VI; that one septum, presumably VI—VII, is absent and that "farther back are three thickened septa which lie between segments VIII, IX and X." Now, I believe, that in ascribing a position to the internal organs we should determine the somite by the septa which bound it. It is true that the septum often appears to have a position which is not in accordance with the limits of the somites as marked externally, but this may be seen in longitudinal sections to be due to the fact that the muscular fibres of the septum adhere for some little distance, either backwards or forwards, to the body wall. Beddard's statement that three septa lie between three "segments" is misleading. Three septa bound two somites. I would interpret the "three thickened septa" mentioned above as septa VIII—IX, IX—X, and X—XI. If this be the case the single pair of testes and ciliated rosettes lie in somite XI. According to Beddard's account of *T. gammi* they lie in somite X, while judging from his figure they would appear to be in somite XII.

I propose to define the present species as follows:—

T. masoni.—Penial setæ of two varieties lying together in the same sac; the one variety very long, with a slight S-shaped curve and a sub-terminal dilation at the distal extremity, while the proximal extremity presents irregular transverse markings; the other variety shorter, somewhat spear-shaped, the distal extremity flattened and furnished with obscurely marked chevron-shaped ridges.

The setæ in about the posterior third of the body are not arranged in couples as in the anterior two-thirds, but are equi-distant from one another, the ventral gap being slightly larger than the interspace between any two setæ.

The spermathecae are provided with two diverticula, the one bifid the other obscurely trifid.

I do not suggest any modifications of Beddard's definition of the genus, but expect that some will be ultimately necessary. As far as we know, neither the character of the diverticula of the spermathecae nor the number of these organs themselves is of generic value. The number of intestinal glands probably varies in different species, and, further, I am not quite sure about the position of the testes.

EXPLANATION OF PLATE III.

Fig. 1. *Typhæus masoni*. Ventral view of the anterior somites. *m.* mouth; *sp.* spermathecal pore; ♀. oviducal pores; ♂. male pores; $p^1p^2p^3p^4$. copulatory papillæ; *c.* clitellum. The roman numerals indicate the numbers of the somites.

Fig. 2. Prostate gland, etc., of the left side from the same worm. *ext.* aperture to the exterior (male pore); *v. d.* vas deferens; *m. d.* muscular duct of the prostate gland; *pr.* the prostate gland; *p. s.* sac containing penial setæ.

Fig. 3. Penial setæ from the same worm. One of each of the two varieties *a.* and *b.* is drawn.

Fig. 4. *Perichæta houlleti*. Prostate gland of the left side. *ext.* aperture to the exterior; *m. d.* muscular duct; *pr.* prostate gland.

Fig. 5. Spermatheca of the same worm seen turned forwards. *sp.* Spermathecal sac proper; ap^1 . large cœcal diverticulum; ap^2 . small cœcal diverticulum.



V.—Notes on Assam Butterflies.—By WILLIAM DOHERTY, Cincinnati, U. S. A. Communicated by THE SUPERINTENDENT OF THE INDIAN MUSEUM.

[Received and Read January 2nd, 1889.]

(With Plate X.)

A collection of butterflies made on the Upper Assam frontier between August and December, afforded material for the following notes. The specimens were taken partly in the hills beyond Margherita, on the border of the independent Naga country, fifty miles due south of Sadiya and the Brahmaputra, and partly on the Dibang and Dikrang rivers north of Sadiya. The season was a very poor one, the cold weather commencing earlier than usual. The number of species taken was so small, and some groups were so poorly represented, that I have thought it best to postpone publishing a list of the butterflies of the district till after my return there next spring.

The dry-season, non-ocellate brood of *Mycalesis*, *Melanitis*, *Junonia*, etc., appeared about the end of September, and none but rubbed and ragged individuals of the wet-season brood were seen flying after that date. *Emona amathusia*, a morphid, turned out to be also dimorphic, as indeed might have been expected. My theory of the effect of drought and humidity (somewhat like that of heat and cold on certain European species) on the shape and ocellation of these butterflies has now received confirmation from various sources. In Eastern Java and the neighbouring islands of Sumba, Sambawa, and Timor, the seasons are the reverse of those in India, the winter months—December, January and February—being the rainy ones. I found the broods of the *Satyridae* similarly reversed there, the wet-season form coming out late in the autumn, and the dry-season one in the spring. This is of course only indirect evidence, but direct evidence has not been wanting. Mr. de Nicéville, who early adopted my views on this subject, some time ago reared *Mycalesis mineus* from the eggs of *M. visala* and has lately bred both forms of *Melanitis leda* under natural conditions from the eggs of the ocellate one. This, however, took place at the time of the change of monsoon. At any other time it must be very unusual for both forms to come from the same parent. Two years ago in the early part of the dry season in the island of Sambawa, I succeeded in obtaining both *Melanitis leda* (*determinata*) and *ismene* from the eggs of *leda* by keeping a wet sponge in the box in which the former species was reared. I particularly recommend this experiment to naturalists living in the East, as *Melanitis* lays its eggs with unusual facility in captivity, and the larva feeds on young growing rice, which is always obtainable. My

chief difficulty with this and other species resulted from my constant change of abode. The dimorphism of many other species yet remains to be demonstrated by breeding. But in these cases, the evidence of the prehensores, in itself irresistible, added to the thousand signs and tokens of identity obvious to any unbiassed field-naturalist, settles beforehand what the results will be.

Another group in which much may be done by breeding is that of the *Euplaeas* included by Mr. Butler in *Salpinx*. Mr. Moore has described a number of Assam species forming the majority of his genus *Pademna*. These are not local varieties. In a single glade in the forest one may find them all, together with dozens of intermediate forms. I have collected species of *Salpinx* in various regions from Malabar to Timor, and even in the smaller islands, where *Euplaeas* of other types are among the most constant of insects, they varied to a remarkable extent. In Upper Assam, where *midamus* is the dominant *Euplaea*, the *Pademnas* more or less resemble that species, and after various fluctuations in the border-country between *midamus* and *core*, they finally assume, in Lower Bengal, a tolerably fixed and constant form (*kollari*) as a mimic of the latter.

In general, however, it seems to me that the results expected from breeding will never be realized, and the formula now much in vogue among lepidopterists—"these forms may be only varieties of ——— but till careful breeding has proved that such is the case, we prefer to keep them distinct"—is about as dangerous as can well be imagined. The burden of proof is thus thrown on the unfortunate breeder, and the describer feels that he can safely neglect the ordinary means of proving a species, examination of a series of both sexes from more than one locality, and an attempt to associate some structural peculiarity of form, sex-mark or prehensores, with the proposed species. The *Pieridæ* have especially suffered in this regard, and in particular *Terias*, *Ixias*, and *Teracolus* have been thus reduced to confusion thrice confounded. Breeding can probably accomplish little with such genera. A group of these butterflies, sitting together on the wet sand, will, in three cases out of four, consist of but one variety, varying little; or, if there is another present, it will usually appear quite distinct. The next stream-bed may contain quite another breed. There is no reason for supposing that these varieties would not, in a majority of cases, breed true. It would be only now and then that the breeder, having overcome the great and greatly underrated (at least in the moister parts of the Eastern tropics) difficulties of rearing a new generation, will find any great variation in his specimens. But even this will prove nothing, because hybridism, which undoubtedly takes place occasionally between butterflies unques-

tionably distinct, must play a great part in such unstable races as those of *Terias*. The results of Mr. de Nicéville's previously mentioned experiment with *Melanitis* (though not, I think, those of mine) may with apparent justice be attributed by some to this cause. It is not by breeding that species like those of *Terias* described by Mr. Moore from Mergui will be invalidated. On examining the forms of different regions, one observes that the genus varies similarly almost everywhere, that the races have no well-marked habitat, and that every fresh locality and season adds links connecting them. The cutting down of forests seems to produce a general amalgamation of varieties which perhaps bred truly before. *Ixias* is a much more variable genus in the scrub jungles of Mount Abu, than in the high forests of Burma. In the open country around Calcutta and Rangoon, there is an inconstancy in the specimens of *Terias* which will rarely be found in the neighbouring tracts still left in their original state. The plants these butterflies feed on, instead of growing here and there in open spaces in the forest, are spread uniformly over extensive districts, and the wandering habits thus originated lead to hybridism and the obliteration of local races. The varieties of *Teracolus*, which are, so far as my experience goes, confined to dry, open country, are by no means so locally true as those of the forest-haunting genera.

It was perhaps the general destruction of forests in the long-settled parts of the East-India, China, Java—whether by the agency of nature or by that of prehistoric man, that gave rise to seasonal dimorphism in the *Satyridae*. In the wet, dark woodland, their ocelli served them as a protection. Then came the change; the country was partly deforested, and, instead of the former uniformly damp climate, there was a long dry season in which the rank vegetation withered, the sunlight entered everywhere, and the ocellate butterflies were rendered conspicuous. Some species disappeared from the regions thus affected, while others lost their ocelli and assumed the angular shape and dull neutral colouring of dry leaves, and so survived. In the less variable climate of the equatorial regions, this has rarely taken place, and generally only the ocellate broods are found there. And in desert regions, instances may perhaps occur where the ocellate form has altogether disappeared.

Other interesting examples of the effect of environment on insect life may be mentioned. The large dark form of *Hypolimnast bolina* called *jacintha* occurs along with the typical race in many neighbourhoods. But I have generally taken *jacintha* in shady jungle, while the other variety may be common in the dry, open country half a mile away. In Assam I observed a remarkable case of similar change in the female of *Appias hippoides*. The normal form is dark above and

below, and but slightly clouded with whitish and dirty yellow. It was usually taken in the forest, moving slowly about in the deep shade, or lying *perdue* among the leaves. The other was almost as brightly coloured with pure white and rich yellow as the male, differing chiefly in the absence of the subapical yellow spot on the forewing below. Like the male it was always fitting up and down the sunny paths at the edges of the wood, only alighting from time to time for a moment or two. Intermediate specimens occurred, and there was no possibility that the species could be different; but the forms were so unlike that they might almost claim to be called dimorphic. I might have hesitated to adopt the conclusion that the differences corresponded with, or perhaps resulted from, the difference in station and habits, if I had not observed precisely the same thing in *Appias nero* in Borneo and the Malay Peninsula. Here again a female almost as richly-coloured as the male,* flies about with it in the sunlight, and a dusky, dull orange form lies hidden in the woods. But it is possible that these differences in the female may correspond with those very slight ones in the male on which Mr. Butler has based his *Appias figulina*, and that two distinct species are in question.

In *Euthalia* and its allies, great differences exist in allied species in the costal vein of the forewing, which in some species is free, and in some anastomosed with the first subcostal branch. I here give a list of the species taken in Assam, and those in the Indian Museum, arranged with reference to this peculiarity :

With the costal vein free.

Symphædra nais,
Lexias teuta,
Lexias teutoides,
Lexias recta,

* Unless my memory fails me, Mr. Forbes, in his "Wanderings in the Eastern Archipelago," observes that the females of *Belenos*, *Catopsilia*, *Appias*, and *Hebomoia* are more conspicuously coloured than the males. Seen against the white floor of a cabinet-drawer, or against a dusty road, they may be, but white backgrounds are not to be found in the jungle as nature made it. There the male of *Appias nero* goes by like a flash of living fire, and the pure white of the male of *Appias leis* or the green-white of the male of *Catopsilia* are of a brightness almost luminous. The dark variegations of the female obviously mitigate their brilliancy. Besides, even the brightest-hued females are more retiring and fonder of the shade than the males are, and hence less obvious. In all probability the female is only more conspicuous than the male in such extraordinary species as that justly called *Hypolimnas anomala* by Wallace, and perhaps in a few such *Lycaenids* as *Biduanda thesmia* and *Catapacilma delicatum*.

Dophla evelina,
Dophla derma,
Dophla ? dunya,
Euthalia lubentina,
Euthalia phemius, (a mimic),
Euthalia aconthea,
Euthalia jama,
Euthalia telchinia, (a mimic),
Euthalia kesava,
Euthalia vasanta,
Euthalia garuda,
Euthalia ? francie,
Euthalia ? sahadeva,
Euthalia ? anyte,
Euthalia ? patala,
Euthalia ? nara.

But of these, one out of five specimens of *nara* and *patala* had the costal vein anastomosed. And while all the seventeen males of *kesava* examined had no anastomosis, it was invariably present in the eighteen females placed under this species in the Calcutta Museum.

With the costal and first subcostal veins united.

Euthalia ? durga,
Lexias ? dirtea,
Lexias ? cyanipardus,
Felderia lepidea, (apparently a protected species),
Felderia macnairi, (apparently protected),*
Felderia iapis,
Felderia andersonii, (apparently protected),
Felderia satropaces, (apparently protected),
Felderia cocytina,
Tanaëcia pulasara,
Tanaëcia cibaritis,
Tanaëcia nicevillei, (a mimic),
Tanaëciaj ahnu,
Tanaëcia adima,
Tanaëcia apiades,
Tanaëcia puseda,
Tanaëcia ? anosia.

* It is mimicked by a new and remarkable species of *Herona* (?) of which both sexes were taken by me in Borneo, and are now in Mr. Neumoegen's possession.

In *durga* one out of six males had no anastomosis, and similar cases occurred in *dirtea* and *cyanipardus*, and apparently in *satropaces*. It is obvious that this feature is not absolutely constant. I have a specimen of *Symphædra dirtea*, female, in which no less than three very conspicuous anastomoses occur, the costal vein being united with the first subcostal branch, the latter with the second, and that with the third. The variation in *Prothoë* is mentioned below. Two years ago I made a list of the Malayan species similar to the above, and it exhibited similar irregularities.

The specimens described below are in Mr. Neumoogen's collection, unless the contrary is stated.

Family SATYRIDÆ.

MYCALESIS (SADARGA) CHARAKA, Moore, (*oculata*). Margherita, only the ocellate form taken.

LEIHE NAGA, n. sp. Pl. X, Fig. 4, ♀. FEMALE, *above* dark fuscous. *Forewing* with a broad white oblique band from the costa (near which it is broader and whiter) to the submedian, above which it is suddenly bent downwards, passing close by the end of the cell but not touching it, its inner border distinct, its outer diffused. *Hindwing* with two pale submarginal lines, the ocelli showing through the wing, especially the white pupil of the fifth. *Below* uniform light fuscous-brown with a slight bronzy lustre. *Forewing*, base unmarked except by a very obscure darker line across the cell, the white band as above, two straight pale submarginal lines and five perfect subequal ocelli (ringed with pale violet), set in nearly a straight line between the lower median and the lower subcostal branch. *Hindwing*, with two irregular transverse darker lines placed unusually close together, and enclosing a narrow space obscurely glossed with violet. They originate below the costal vein, the inner crossing into the cell at the origin of the upper discocellular, and continuing parallel with it to the hind margin of the cell halfway between the forkings of the median vein, continued obscurely through the submedian space. The outer line runs in a parabola from the costal vein to the upper median, skirting but not touching the end of the cell, and, crossing the base of the upper median space, disappears above the last ocellus. Ocelli six, all large, perfect, with white pupils surrounded by black and ochreous and set in a large violet-whitish ring. The first is within the line of the others, and is extremely large, the next three subequal, the next larger, the sixth geminate, with two separate white pupilled black spots in a yellow field. Two wavy submarginal pale lines.

A single female, near Margherita. It is very large—about three and a half inches in expanse. The hindwing has almost no outer angle, the forewing has the outer margin straight (rounded in *verma*, etc.) and the lower angle not cut away (as in *hyrania*). The last bifurcation of the median vein of the hindwing takes place a little before the end of the cell. The species has no near allies. *Lethe margaritæ*, Elwes (*Neorina** *margaritæ*, Marshall and de Nicéville), which it apparently connects with the other *Lethes*, obviously differs in the white band of the hindwing below, and the white scales diffused over the under surface. As in *margaritæ*, the white band of the forewing is probably absent in the male.

Family ELYMNIADÆ.

DYCTIS PEALII, Wood-Mason, Pl. X, Fig. 3, ♀. Sadiya and Margherita. The FEMALE differs greatly from the male in this handsome species. The tails are much longer than in the male—longer even than in *Elymnias caudata*. Above, the wings are tinted with blue instead of violet. Forewing with the subcostal band very obscure, the cell dark, the disc pale. Hindwing with a conspicuous rufous-orange anal spot occupying the entire breadth of the submedian space, the violet submarginal band of the male replaced by a short bluish fascia thence to the large discal and apical pale area. Below, the entire forewing, except the cell and the outer margin, is clouded with large violet-white striæ, and so is the apical and part of the discal area of the hindwing.

Family MORPHIDÆ.

ÆMONA AMATHUSIA, Hew. (*pealii*, W.-M.). *Æ. pealii* appears to be the wet-season form of *amathusia*, differing only in the less acute and falcate forewing, the more distinct ocelli, and brighter colouring below, the usual differences between seasonal forms in India. I took two specimens of *pealii* near Sadiya in September. The outer margin of the forewing was convex throughout, but the apex was slightly more acute than in the type. On the first of December, I caught a single ragged specimen of *amathusia* near Margherita, apparently quite typical.

* That species is of course a *Lethe*. The true *Neorinas* are singular insects, and can only be retained in the *Satyridae* on account of the difficulty of putting them anywhere else. I have often observed *N. lowii* in Borneo, the Malay Peninsula, and Eastern Java (where, however, the local representative may be distinct). It is continually changing its perch, flitting round and round the passers-by, and alighting with the wings partly or wholly open. When flying, it has the strongest possible resemblance to *Papilio helenus*, and it may possibly be advantageous for a scarce, rather weak-flying insect of morphid or satyrid affinities to resemble a common *Papilio* of powerful and irregular flight.

Family APATURIDÆ.

POTAMIS (or APATURA) ULUPI, n. sp. Pl. X, Fig. 2, ♂.

MALE, *above, forewing*, black, quite unglossed, markings light ochreous-fulvous, the base, costa, hind-margin, and a few submarginal touches diffused rufous-brown; two small light ochreous spots above the radials, the upper largest; an obliquely transverse fulvous macular band from the subcostal vein to the lower angle, the first three spots being elongate-quadrate, separated only by veins, the last with a pale space beyond it, the fourth well separated from the first three, outwardly incised, the fifth subquadrate, diffused, close to the outer margin, with a large black spot partly enclosed by its inner border, the sixth slender, lying along the margin of the interno-median space; another transverse band from the upper edge of the cell to the submedian vein sloping obliquely outwards, and divided into three parts by the median vein and its lower branch, occupying the middle half of the cell (with a diffused streak at the lower angle, almost separated from it by an oblique black crescent), the basal half of the lower median and half of the interno-median space. *Hindwing* ochreous-fulvous, the abdominal margin as far as the lower, and in the middle of the disc the upper median branch, covered with diffused black scales, the apical part also sordid, the veins dark, the marginal line and a broader submarginal line thickened at the crossing of the veins, black, within which is a line of five partly united dark spots diminishing anally to mere streaks. A large and distinct black spot discally in the lower median space.

Below, forewing, paler tawny, the black spaces above replaced by dusky fulvous ones, except a large black spot in the lower median space, and a diffused blackish one below it, near the lower angle of the wing. The two subapical spots, and a touch on the costa beyond the cell, lilac-white. *Hindwing* light fulvous, the base slightly glossed, pale; a large ocellus pupilled with purple in the lower median space; a lustrous lilac-white band across the wing discally, bordered inwardly by a darker ferruginous band broadest near the costa; a submarginal ferruginous line, within which are a few obscure lilac-white touches, between which and the lilac band lie four good-sized lilac-white spots and some ferruginous touches.

One male taken by Lieut. Hartert on the Dikrang near Sadiya, another by me at Kobong between Sadiya and Margherita. One or two others were seen.

This butterfly has no near allies. In general appearance it is something like *Dilipa morgiana* or *Sephisa dichroa*. In its small body and rather weak flight it resembles *Apatura* (*Eulaceura*) *osteria*, and if

the female turns out to have two parallel raised processes on the under-side of the abdomen, as in that species, it might be classed with it. But it seems nearer the European *iris*, though so differently coloured. The border is less serrate, the forewing more falcate, and its costa longer than in any other *Apatura*. The abdominal margin of the hindwing is long and the outer margin not much rounded. The radial veins of the forewing are unusually approximate basally, and the last bifurcation of the subcostal is unusually near the margin. It is remarkable that the varieties of *Apatura namouna* and *Dilipa morgiana* found in the Naga Hills, judging from the specimens in the Indian Museum, differ from Sikkim specimens and somewhat resemble this species in their smooth-bordered elongate wings, weak bodies, and dull colouring.*

PROTHOE REGALIS, Butler, var. One ragged male taken near

* In a paper which appeared in this Journal in May, 1886, the corrections to which arrived too late for publication, *Potamis* (*Apatura*) *namouna* was by a clerical error placed among the *Nymphalidæ*, instead of among the *Euripinæ* at the top of the preceding page. This group, like the *Doleschallinæ* and *Charaxidæ* (which by a similar error were placed between the *Apaturidæ* and *Nymphalidæ*) seem intermediate between the *Apaturidæ* and *Satyridæ*. As *Charaxes* is partially connected with the *Euripinæ* by *Prothoë* and *Mynes* it had better be placed as a sub-family at the end of the *Apaturidæ*. The name *Bybliidæ* must be substituted for *Eurytelidæ*. *Kallima*, it seems, is a true apaturid, near *Rhinopalpa* and *Hypolimnas*. There is no important difference between the *Junonia* and *Apatura* groups, though the *Vanessa* group seems distinct enough. So much confusion arises from the use of the names *Nymphalis* and *Apatura*, that it is a pity that they cannot be dropped altogether. The *Apaturidæ* might then stand as the *Vanessidæ*, the *Nymphalidæ* as the *Neptidæ*. The latter including *Limenitis*, *Adelpha*, *Neptis*, *Euthalia*, *Parthenos* and their allies is a well separated group; the former can only be separated from the *Satyridæ* and *Morphidæ* by an artificial line. The long series of genera from the most primitive morphid to the highest apaturid (*Cynthia* or *Cethosia* for instance) forms almost an unbroken chain. The anomalous genus *Pseudergolis*, in which the forelegs of the female, though small, are quite perfect, might be formed into a separate family, or subfamily. The undescribed female of *P. avesta*, which exhibits this peculiarity, has but little resemblance to the male, but is a close mimic of *Precis iphita*.

Libythea seems more allied to *Hamadryas* and the *Neotropidæ* than to the *Pieridæ*. Of the *Erycinidæ*, the American *Lemoninæ* (with their reticulate eggs) seem very much nearer the *Lycenidæ* than their Eastern allies are, though no doubt all three are related. The arrangement adopted with the *Hesperiidæ* cannot stand, and I have altogether remodelled it. The statement that the enclosed spaces (laterally) on the eggs of *Lycenidæ* were tetragonal was inadvertent. They are trigonal, tetragonal, hexagonal, or wholly irregular, according to the genus and sub-family. My work on eggs and young larvæ still progresses, and on account of the great number of genera covered, it may, I hope, prove a useful supplement to the labours of Scudder and Edwards.

Margherita, and one seen near Sadiya. The former agrees with *regalis* in the dusky underside, and the very broad blue band and five blue spots of the forewing above, but the hindwing and the base of the forewing have an obvious violet gloss, though they are not, as in *angelica*, powdered with bluish-white scales. The costal and first subcostal veins of the forewing are well separated. Mr. de Nicéville thought that this occurred only in *P. caledonia* (*Mynes calydonia*, Staudinger). But *P. angelica* has the veins sometimes free and sometimes united.

Family NYMPHALIDÆ.

TANAËCIA ADIMA, Moore. Margherita. This species has the hindwing sometimes wholly brown, sometimes with a narrow macular band of blue over three or four spaces marginally. These and intermediate forms are all found in the same locality. I am inclined to think the species distinct from *apiades*, though very near it.

Family LYCÆNIDÆ.

Sub-family LYCÆNINÆ.

PITHECOPS FULGENS, n. sp., Pl. X, Fig. 6, ♂. MALE, above black, forewing with the cell, the interno-median space and the disc to the lower radial, resplendent cyaneous blue in some lights, dull violet in others, the black border wide, extending one-third towards the base. Hindwing similarly blue from the lower subcostal to the submedian, the black border somewhat narrower, especially towards the anal angle. Cilia of hindwing whitish except at the ends of the veins. FEMALE, above blackish, the costa and outer margin of the forewing darker. Cilia of the forewing pale, of the hindwing white.

Below, both sexes pure white, a very slender dark marginal line, a narrow submarginal white band containing a line of six minute dark transverse streaks in the forewing and five in the hindwing, within which is a narrow transverse ochreous-brown fascia very clearly defined (in the hindwing by an obscure dark line on its inner border), extending across the whole breadth of the forewing and on the hindwing from the upper subcostal to the submedian vein. Traces of slender discal streaks in the forewing near the lower angle within the ochreous band. Apex of forewing obscured with black scales, hindwing with a large and conspicuous subapical black spot extending from the costa to the lower subcostal vein.

Margherita, where it perhaps takes the place of *P. hylax*. According to Mr. de Nicéville, that species is in Sikkim much commoner than *Neopithecops*, which I did not see in Assam at all. But in the Chittagong

Hill Tracts, at Sandoway and Bassein in Burma, in Tenasserim, and in the Malay Peninsula, *Pithecopa* is the rarer form. In Java it is *Neopithecopa* that is rare, another instance of its close faunal resemblance to the Himalayas. In the Celebes, I did not observe any *Neopithecopa*, but a large protected *Pithecopa* (*P. phœnix*, Röber) is very common and conspicuous. On the other hand, *Neopithecopa* seems to occur alone in Malabar (where I found it as far north as the Gersapa Falls in North Kanara), and Ceylon, and also, so far as my experience goes, in the islands of Lombok, Sambawa, and Sumba east of Java.

The genera differ in many important points. As regards prehensores, the clasp (*harpago*) of *Neopithecopa*, seen from the side, is simply clavate at the tip, while that of *Pithecopa* is long and slender and ends in two opposing points like a pair of pincers. As to the egg, in that of *Neopithecopa* the raised lines form triangles laterally, in that of *Pithecopa* quadrangles. Both genera are apparently more or less protected, and are mimicked by certain rare species of *Logania* (*Gerydinæ*) and *Cyaniris* (*Lycœninæ*).

Sub-family PORITINÆ.

MASSAGA HARTERTII, n. sp., Pl. X, Fig. 1, ♂. MALE, above black, markings in some lights lustrous sea-green, in others more or less bluish, the tips of the scales being blue and slightly bent downwards. Forewing with six submarginal spots, the upper five small and subequal, arranged in a linear series, the lower slightly nearer the base, oblong and much larger than the others; a slender oblique fascia beyond the cell, divided by the radials into three parts, the lowest longest; a stripe along the lower side of the median vein, extending to the base, a small part of it lying beyond the lower median branch, which divides it; beyond this a wider transverse discal spot, divided by the middle median into two portions outwardly dehiscent; another stripe along the hind margin almost from the base, the outer end inclined upwards, with a minute spot above its termination, separated from it by the internal vein. Hindwing with a large pale costal area, a tuft of long hairs, appressed in the direction of the apex, on a gland which forms a raised elliptical line on the underside above the origin of the first subcostal vein; submarginal spots four, a diffused one extending from the median halfway to the submedian vein, a large obliquely-semicircular one dark in the middle, in the lower median space, a narrow crescent close to the marginal black line in the upper median space, and a small diffused spot in the next space, partly united with the upper discal spot. Discal spots three, one occupying the submedian space from its base, constricted in the middle, the clavate end occupying

the whole breadth of the space; beyond this two spots of moderate size in the median spaces discally. *Below* rufous-brown with a slight bluish gloss. *Forewing* with a broad white band beyond the cell, from the costa (where it is narrowest) almost to the hind margin; beyond it a broad space of darker, richer brown, then a row of seven delicate whitish transverse submarginal streaks, of which the upper three are most distinct, crescent-shaped, the others obscure and irregular. Beyond these a paler space, with three whitish streaks, parallel with and close to the upper three of the inner series. •Margin chestnut brown, cilia chiefly light. *Hindwing*, basal part unmarked, a broad white band crossing the wing from the costa, occupying the outer third of the cell, its inner margin well defined, and but slightly irregular. The disc is covered with large rufous-brown markings in two very irregular series, the first four (those above the radial) on a white ground, the others on a ground obscurely clouded with violet and whitish scales. Two of these spots in the inner series and the median spaces, are much larger than the others, the outer one quadrate. A dark wavy outer discal line extends on a white ground to the upper median, where it is interrupted, and from there to the anal angle on a whitish ground. Marginal line orange-brown, bordered inwardly by a silvery line, between which and the wavy discal line are, in the upper median space a blackish area, in the lower median space a gray area, and thence to the anal angle a blackish line inwardly bordered with reddish. Cilia basally grey, outwardly dark.

From *Poritia phalena*, Hewitson, (Singapore), of which it seems to be the northern representative, it differs in the narrow streak below the cell in the forewing, with the bifid spot beyond it, and in the long mark in the hind margin. The hindwing below is quite different, much less white, the discal spots larger and of the general ground-colour, the submarginal spots absent and the apical rufous-brown space greatly reduced.

In the right forewing the first subcostal branch is wholly absent. This interesting aberration may be of frequent occurrence in this group, and may have been the cause that Moore, Felder, and Distant passed over this vein in their descriptions of the genus.

The egg probably agrees with that of the other species of the subfamily. It is a truncate pyramid, the base somewhat convex, nearly twice as long as wide; a horizontal apex, two vertical and two sloping sides, the former trapezoidal, reticulate near their upper edges, the latter and the apex nearly square, delicately reticulate. In the ovarian tubes of the female, these eggs are found in pairs, attached by their bases. Along with those of *Liphyra brassolis*, they are the most remarkable eggs in the family.

The chrysalis somewhat resembles those of the *Erycinidæ* and strikingly illustrates the singularity of the group. It is suspended, not girt, but rigidly inclined towards the surface of the leaf. It is less compact in form than that of other *Lycænidæ*, and is studded with bristles. Of these a number on the side of the head are white, with two black ones on each side of the top of the head, and one black one on each side of the thorax above the thoracic angle. The second, third, and fourth abdominal segments have each a lower white and an upper black bristle approximate laterally, while the last segments have a number of white lateral and of black subdorsal ones. The ground colour is ochreous much marked with dark, especially on the upper surface of the abdomen, each segment having a black line near its hind margin, except the first which has two distinct black spots dorsally. The wing-covers are veined and bordered with brown.

I name this species after my fellow traveller in Assam, Lieutenant Ernst Hartert, the ornithologist and African traveller, who obtained the sole specimen.

Sub-family THECLINÆ.

ZEPHYRUS PAVO, de Nicéville. A single specimen taken near Margherita at only four hundred feet elevation. Though a male, it precisely agreed with Mr. de Nicéville's description of the (unique) type, which was very likely also a male, though described as a female.

TICHERRA ACTE, Moore. The very distinct dry-season form, non-ocellate and dusky fuscous below, was first seen in November, as well as that of *Cheritra freja*, while that of *Loxura atymnus* appeared early in October.

DACALANA VIDURA, Horsf. This species, which is rare in Assam, though common in the Malayan region, has the habit of alighting on the underside of leaves (with closed wings), disappearing in the act as if by magic. It is a ground butterfly, living among bushes. *Neomyrina hiemalis*, which alights in precisely the same manner, is on the other hand a tree butterfly, and rarely descends within reach of the net. When flying it strongly resembles the white species of *Cyrestes* and the moths of the genus *Urapteryx*, the latter being apparently a protected group.

Family PAPILIONIDÆ.

PAPILIO (*PANGERANOPSIS*) *ELEPHENOR*, Doubleday. Two males of this rare species, Dikrang near Sadiya.

PAPILIO (*EUPLOEOPSIS*) *TELEARCHUS*, Hew. The undescribed female of this species appears to be dimorphic, one form resembling the male,

and the other the female, of *Euplœa midamus (linnæi)*. Both were taken on the Dikrang near Sadiya.

Family HESPERIADÆ.

Gehlota-group.

GEHIOTA, n. g. I separate *Plesioneura sumitra*, *leucocera* and their allies under this name. The typical *Plesioneura*, *alysos*, Moore (? = *curvifascia*, *Felder*), is closely allied to *Astictopterus* and *Kerana*. Like them it lies quiet in shady places, flying only now and then, and slowly; alighting with closed wings. The egg, like that of *Kerana*, is of the lowest type among butterflies. It is limpet-like, greatly flattened, red, leathery, nearly smooth (the ribs are visible only near the base), with a broad transparent basal carina. *Sumitra* is on the other hand one of the swiftest and most active of insects, incessantly whirling around flowers, or patrolling up and down a path, almost invisible from the rapidity of its flight. Like its allies of the *Tagiades* group, it alights with open wings. The egg is more than three-fourths as high as wide, generally white, with very numerous (three times as many as in *Tagiades*), sharply cut ribs, and a greatly contracted base without carina. I postpone a comparison of the structure of the imagines.

GEHLOTA PINWILLI, Distant. One male, *Margherita*, agreeing well with Mr. Distant's description and figure. The species resembles *hypsinæ* and other *Cethosias* in colouring. If this is a case of mimicry it has its parallel in that of an *Agarista* only two inches in expanse, which obviously mimics the great Bornean *Hestias*. The enemies of butterflies seem not quite able to grasp the fact that they do not grow.

Suastus-group.

PLASTINGIA MARGHERITA, n. sp., Pl. X, Fig. 5, ♂. MALE, above black, with light golden-ochreous translucent markings, and richer orange-ochreous opaque ones. Of the former there are on the *forewing*, two unusually large, elongate-quadrate, subapical ones, separated by a vein, the lower longest: one large oblique cellular one of hour-glass shape; and three discal ones in echelon, of which one is very large, occupying the entire breadth of the lower median space, irregularly pentagonal, twice as long as broad, separated from the cell-spot only by the black median vein; the other two smaller, elongate, broadest outwardly. Also with the following opaque markings:—one above the cell and one in the interno-median space, extending obliquely from the internal vein, not far from the base, to the lower median vein, which separates it from the basal part of the larger discal spot. *Hindwing* with a large irregular

ochreous patch in the disc just beyond the cell, consisting of two translucent areas joined by the opaque orange-ochreous base of the upper median space, the outer one larger, obliquely quadrate, between the lower subcostal and upper median branches, the other occupying the basal part of the lower median space.

Below blackish, the veins, except near the abdominal margin of both wings, widely bordered with reddish-ochreous. *Forewing* with the rufous costal area extending over the upper part of the cell; that in the interno-median space much larger and paler than above. *Hindwing* with a number of lustrous lilac markings in the black spaces between the reddish nerve-rays, namely, two in the cell, the basal one elongate, one at the base of the costa, elongate, two in the upper subcostal space, the outer one elongate, one in the lower subcostal space, quadrate, and three in the median and submedian spaces, in a line receding from the border. Cilia ochreous.

One male, Margherita, and a similar one, Sadiya. The species is a local form (differing in the large subapical spots, the absence of the outer—fourth—discal spot, the undivided coll-spot separated from the interno-median one, and in the ochreous patch of the hindwing consisting of two hyaline and one opaque space and confined to the disc) of another found in the three Indo-Malayan islands, the Malayan Peninsula, and Mergui, but everywhere rare. The Javanese form (*callineura*) seems, judging from my specimens, to differ but slightly. The single, very worn Mergui specimen, taken by Dr. Anderson, has been identified by Mr. Moore as *Plastingia latoia*, Hewitson. But that species (and *P. callineura*, Felder, which is regarded as conspecific with it) has been described and figured by Hewitson, Felder, and Distant with ochreous submarginal spots on the hindwing below, no blue ones being mentioned. In any case the above-mentioned characters separate my species as a distinct local form.

The egg of several species of *Plastingia* examined by me generally resembles that of *Suastus*. But like those of *Hesperia satwa*, de Nicéville, and the species of *Cupitha*, though in a lesser degree, it possesses a large crown-like mass of white cells apically, surrounding the micro-pylos, as delicate in structure as the finest lace. They are the most beautiful butterfly-eggs known to me.

Ismene-group.

CAPILA JAYADEVA, Moore. One female, Margherita. I mention this species because according to Mr. Elwes it has never been recorded from anywhere except Sikkim.

Tagiades-group.

SATARUPA NARADA, Moore. Margherita, where *S. bhagava* also occurs.

CALLIANA PIERIDOIDES, Moore. This extraordinary genus and species were described from a single bad specimen without locality, from Grote's Indian and Burmese collections. I obtained several males near Margherita, but no females. They fly in the darkest parts of the forest towards the end of the afternoon,* alighting, like the other butterflies of the *Tagiades* group, with outspread wings. In the morning they lie concealed, adhering closely to the underside of leaves.

No one who sees it floating lazily with level wings up and down the bed of a stream, its pure-white upper surface singularly conspicuous in the gloom of the jungle, can doubt that the species is protected. I see no reason to suppose that it mimics any Pierid. In a very vague way it resembles the geometrid genus *Euchera*, which is likewise protected, and has somewhat similar habits.

The entire body and wings of this butterfly are saturated with a powerful and delicious odour of mingled vanilla and heliotrope. This is often perceptible as it flies past. After pinching the insect, the scent is sometimes obvious for hours afterwards on one's fingers. After lying two weeks in its paper, a dried specimen still gave out perfume. None of the sweet-smelling lepidoptera known to me, not even the *Lethes*, *Euploeas*, or *Callidulas* have a more powerful odour. Yet it seems to have no specialized scent-organs (such as those genera have), unless the tufts on the hind-tibiae, present in many other hesperians, be so considered.

I unluckily caught no female, though I once saw a male circling round a dark-coloured hesperian, which escaped. It is perhaps rash to speculate where certainty may before long be attained, but the female is most likely dark. For the male seems protected only by the intensity of its sweet odour (just as the aromatic herbs of Hymettus and Cyllene, as the shepherds there told me, are protected from cattle by the same pleasant fragrance that attracts the bees), and no female known to me has any sweet odour at all. Odours common to both

* Prof. Wood-Mason tells me that this is a common habit among the *Hesperiadæ*. In Cachar a great many species used to come late every afternoon to visit a certain plant with blue flowers. This seems to me a most interesting fact, illustrating the close relationship between the *Hesperiadæ* and the *Sphinges*. I have never observed anything similar myself, though some of the *Ismenes*, especially the house-haunting sorts like *Parata chromus*, etc., often fly about at sunrise and sunset, alighting on rocks and walls.

sexes are, as in *Agarista*, *Radena*, and *Acraea*, invariably bad. And I know of no case where a female has any peculiar odour of its own.

I add figures of *Remelana yajna* (Himalayas) and *Castalius manluena*, Felder, (Nicobars), described in this Journal in 1886.

EXPLANATION OF PLATE X.

- Fig. 1. *Massaga hartertii*, n. sp., ♂, p. 128.
 „ 2. *Potamis* (or *Apatura*) *ulupi*, n. sp., ♂, p. 125.
 „ 3. *Dyctis pealii*, Wood-Mason, ♀, p. 124.
 „ 4. *Lethe naga*, n. sp., ♀, p. 123.
 „ 5. *Plastingia margherita*, n. sp., ♂, p. 131.
 „ 6. *Pithecopa fulgens*, n. sp., ♂, p. 127.
 „ 7. *Remelana yajna*, Doherty, ♂, p. 134.
 „ 8. *Castalius manluena*, Felder, ♂, p. 134.



JOURNAL

OF THE

ASIATIC SOCIETY OF BENGAL.



Part II.—NATURAL SCIENCE.

No. II.—1889.

VI.—*The Tornadoes and Hailstorms of April and May 1888 in the Doab and Rohilkhand.*—By S. A. HILL, B. Sc., *Meteorological Reporter to the Government of the N.-W. Provinces and Oudh.*

[Received October 6th;—Read November 7th, 1888.]

(With Plates IV—IX.).

The early part of last hot weather was remarkable for the number and severity of the atmospheric disturbances which occurred all over Northern India. In the beginning of April the most violent disturbances took place in Bengal, and chief amongst these was the tornado at Dacca, an account of which has been published in this Journal (Vol. LVII, Pt. II, p. 185) by Mr. Pedler and Dr. Crombie. At the end of April and in the beginning of May there were several very destructive storms of a similar character in Rohilkhand and the Upper Doab, together with a number of less violent disturbances accompanied by hail on the outer Himalayas. The peculiar and distinctive feature of the three most important storms of this period was the extraordinarily destructive character of the accompanying hail, which, owing either to the immense size of the hailstones and the velocity with which they fell, or to the great quantity of the hail and the low temperature it caused, was most unusually fatal to human and animal life, as well as

destructive to crops and trees. All the storms referred to occurred on the 30th April or the 1st May; though in some places there was a slight tendency to their recurrence on the 2nd May.

GENERAL WEATHER OF THE PERIOD.

The general features of the weather of Northern India during the week ending with the 2nd May may be gathered from the following tables compiled from the telegraphic reports published by the Simla Meteorological office.

26th April, 1888.

STATION.	Pressure at 8 A. M.	Change since previous day.	TEMPERATURE			WIND.				Weather Remarks.	
			8 A. M.	Maximum.	Minimum.	Direction.	Mean Velocity per hour	Humidity 8 A. M.	Cloud 8 A. M.		Rainfall.
Simla ...	23 160	+ .009	58 0	70 7	53 1	N. E.	..	89	2	...	
Chakrata ...	23 169	+ .022	63 7	71 3	54 3	E.	6	32	...	...
Mussooree...	23 328	+ .030	66 0	73 5	56 0	N N E	12	41	...	...
Ranikhet ...	23 996	+ .020	65 6	74 5	59 0	S E.	8	38	4	...	Fine.
Lahore ...	29 681	- .022	83 2	100 6	62 0	C.	2	30	2	...	Clear.
Ludhiana ...	29 666	- .011	82 2	102 8	68 0	C.	2	30	4	...	Fine.
Roorkee ...	29 675	- .005	79 3	98 6	65 2	C.	6	32	...	...	Hot wind.
Meerut ...	29 693	+ .004	82 9	99 3	68 5	N. W.	5	30	...	...
Bareilly ...	29 700	+ .025	80 9	99 7	68 5	E.	5	26	...	...
Gorakhpur...	29 756	+ .047	74 3	95 8	70 8	E.	5	74	5	...	Threatening.
Ajmere ..	29 749	- .068	86 3	101 3	81 5	W.	8	46	...	...
Jeypore ...	29 758	- .037	84 6	100 1	74 0	W.	5	31	...	...	Dust haze.
Agra ...	29 723	- .021	85 7	103 0	76 5	W.	6	28	...	...
Lucknow ...	29 740	+ .041	78 7	105 8	65 4	E.	6	73	...	...
Allahabad ..	29 716	+ .027	86 3	101 5	70 6	S. E.	7	21	...	...	Hot wind.
Benares ...	29 726	+ .056	79 6	102 8	69 6	C.	7	55	...	...
Patna ...	29 766	+ .041	78 5	97 5	70 2	E.	7	72	2	...	Fine.
Gya ...	29 744	+ .025	86 7	102 5	68 8	C.	6	69	5	...	"
Sutna ...	29 756	+ .027	83 2	99 1	68 6	N. W.	9	42	...	...	"
Nowgong ...	29 743	+ .006	83 7	100 1	75 6	S. W.	4	18	5	...	Fine.
Jhansi ...	29 725	- .001	84 5	102 5	76 9	N. W.	6	29	3	...	"

On the 26th the atmospheric pressure was nearly normal all over Upper India, but the westerly winds of the previous days had fallen off in strength and many calms were reported, whilst easterly winds were advancing over Behar and eastern districts of the N.-W. Provinces.

27th April.

STATION.	Pressure at 8 A. M.	Change since previous day.	TEMPERATURE.			WIND.		Humidity 8 A. M.	Cloud 8 A. M.	Rainfall.	Weather Remarks.
			8 A. M.	Maximum.	Minimum.	Direction.	Mean Velocity.				
Simla ...	23 225	+ 065	62 5	72 5	53 1	N E.	.	56	2	..	Clear.
Chakrata ...	23 240	+ 071	67 2	76 8	60 3	S. W.	7	24	..	..
Mussooree ...	23 390	+ 062	66 5	76 0	60 5	N.	14	37	..	..
Ranikhet ...	24 028	+ 032	70 0	77 0	63 5	W.	8	31	Hot wind.
Lahore ...	29 705	+ 024	86 7	103 1	69 9	O.	2	38	2	..	
Ludhiana ...	29 679	+ 013	83 7	104 8	73 0	C.	1	37	8	..	
Roorkee ...	29 727	+ 052	83 8	103 1	72 1	S.	5	41	Strong wind.
Meerut ...	29 742	+ 049	81 5	103 8	71 9	N. W.	3	37	4	..	
Bareilly ...	29 744	+ 044	80 4	101 3	70 5	S E	4	64	..	..
Gorakhpur...	29 783	+ 027	74 3	94 8	70 3	S S E	6	74	4	..	Dust haze.
Ajmere ...	29 798	+ 049	84 3	103 8	82 5	W.	15	50	..	..
Jeypur ...	29 774	+ 016	88 6	105 1	78 9	N. W.	7	33	..	..
Agra ...	29 725	+ 002	91 2	107 0	80 9	W.	3	28	Hot wind.
Lucknow ...	29 768	+ 028	77 7	106 3	73 8	E.	5	71	...	..
Allahabad ...	29 741	+ 025	80 7	105 6	74 1	E.	6	60	1	..	
Benaies ...	29 746	+ 020	77 6	104 8	74 0	E N E	7	70	Dust haze.
Patna ...	29 779	+ 013	75 0	91 4	68 7	E N E	9	81	10	..	
Gya ...	29 746	+ 002	83 7	102 5	73 3	N E.	6	59	..	..
Satna ...	29 720	- 036	90 7	104 6	74 1	N.	9	18	Hot wind.
Nowgong ...	29 741	- 002	86 8	106 6	75 6	W.	3	25	..	..
Jhansi ...	29 721	- 004	90 7	108 5	85 4	N. N. W.	5	34	..	..

Pressure had increased slightly on the 27th but the distribution was almost unaltered. The weather was still fine and rainless, but the easterly winds continued and humidity was increasing over the eastern districts.

28th April.

STATION.	Pressure at 8 A. M.	Change since previous day	TEMPERATURE			WIND		Humidity 8 A M	Cloud 8 A M	Rainfall.	Weather Remarks.
			8 A. M.	Maximum	Minimum	Direction	Mean Vel				
Simla ...	23 196	- 029	63 2	76 0	57 4	W.	..	35	3	..	Gloomy.
Chakrata ...	23 193	- 047	69 1	74 8	61 3	N.	8	19	4	..	
Mussooree...	23 350	- 040	70 0	76 5	61 0	O.	14	36	7	..	
Ranikhet ...	24 020	- 008	71 5	77 0	61 0	W.	8	33	..	..
Lahore ...	29 660	- 045	81 2	104 1	70 4	C.	1	45	8	..	

STATION.	Pressure at 8 A. M.	Change since previous day.	TEMPERATURE.			WIND.		Humidity 8 A. M.	Cloud 8 A. M.	Rainfall.	Weather Remarks.
			8 A. M.	Maximum.	Minimum.	Direction.	Mean Velocity				
Ludhiana ...	29.619	-.060	85.2	107.8	71.0	C.	..	32	8	...	Hot wind.
Roorkee ...	29.657	-.070	80.8	103.6	70.1	N. E.	5	27	6	...	
Meerut ...	29.658	-.084	85.8	105.2	72.9	N. W.	3	40	...	...
Bareilly ...	29.676	-.068	81.9	102.8	70.0	S. E.	4	54	3	...	Strong wind.
Gorakhpur...	29.767	-.016	77.7	92.8	73.8	S. S. E.	1	75	1	...	
Ajmere ...	29.750	-.048	81.8	103.3	81.5	W.	16	50	5	...	
Jeypore ...	29.742	-.032	87.6	105.1	75.9	N. W.	8	14	6	...	Hot wind.
Agra ...	29.695	-.030	90.7	109.5	81.4	W.	7	24	...	...
Lucknow ...	29.730	-.038	82.2	105.3	75.8	E.	5	62	...	...
Allahabad ...	29.713	-.028	87.3	105.6	77.6	E.	4	49	Dust haze.
Benares ...	29.707	-.030	82.4	101.8	79.0	E.	6	61	...	...
Patna ...	29.761	-.018	80.6	90.9	72.7	E.	6	74	...	...
Gya ...	29.735	-.011	85.7	108.1	73.3	N. E.	4	56	Strong wind.
Sutna ...	29.711	-.009	92.7	107.2	77.6	W.	12	15	...	...
Nowgong ...	29.723	-.018	91.8	107.1	71.6	W.	4	18	...	...
Jhansi ...	29.708	-.013	90.6	108.5	84.4	N. W.	7	31	2	...	

The barometer had now commenced to fall briskly on the N.-W. Himalaya and at adjacent stations, and this fall was accompanied by a further advance of the easterly winds along the outer hills. The humidity was slightly less at most of the observing stations, but cloud had increased over the hills. There was still no rain.

29th April.

STATION.	Pressure at 8 A. M.	Change since Previous day	TEMPERATURE.			WIND.		Humidity 8 A. M.	Cloud 8 A. M.	Rainfall.	Weather Remarks.
			8 A. M.	Maximum.	Minimum.	Direction.	Mean Velocity				
Simla ...	23.144	-.052	61.5	77.5	59.3	N. E.	...	44	3	...	Fine.
Chakrata ...	23.179	-.014	68.2	79.3	59.3	C.	6	40	2	...	
Mussoorie...	23.334	-.016	69.0	77.0	60.0	N.	13	48	2	...	
Ranikhet ...	24.014	-.006	68.5	79.5	62.5	W.	8	45	Hot wind.
Lahore ...	29.605	-.055	81.7	104.1	69.9	C.	2	47	4	...	
Ludhiana ...	29.586	-.033	86.7	107.3	74.6	C.	...	39	4	...	
Roorkee ...	29.622	-.035	85.3	104.1	73.1	S.	3	15	2	...	Fine.
Meerut ...	29.645	-.013	81.9	106.2	73.9	N.	2	65	10	...	
Bareilly ...	29.644	-.032	85.9	102.8	78.0	S. E.	3	55	4	...	
Gorakhpur...	29.692	-.075	81.2	95.3	77.3	S. S. E.	5	67	2	...	Hot wind.
Ajmere ...	29.666	-.084	85.3	104.3	82.0	W.	13	52	6	...	
Jeypore ...	29.661	-.081	87.6	105.6	79.4	E. S. E.	7	36	3	...	
Agra ...	29.624	-.071	89.2	110.5	84.4	W.	6	32	3	...	Fine.
Lucknow ...	29.673	-.057	86.6	102.3	78.8	C.	2	50	5	...	
Allahabad ...	29.637	-.076	88.8	106.6	79.3	E. N. E.	4	48	4	...	
Benares ...	29.655	-.052	84.9	104.8	81.4	E.	5	59	3	...	Strong wind.
Patna ...	29.747	-.014	80.1	94.9	75.7	E.	6	82	...	...
Gya ...	29.691	-.044	89.7	101.5	75.3	C.	4	56	7	...	
Sutna ...	29.616	-.095	93.7	107.2	77.1	W.	10	23	Hot wind.
Nowgong ...	29.641	-.082	92.8	108.1	77.6	W.	5	25	5	...	
Jhansi ...	29.690	-.018	90.6	109.6	84.9	N. W.	6	28	4	...	

On the 29th there was a further considerable fall of the barometer, especially over the western desert. Pressure was now unusually low everywhere. Strong west winds were blowing over Rajputana and Bundelkhand and the temperature in the day time was very high, maxima of 110° and upwards being reported for the previous afternoon at Agra and other places. The humidity had increased considerably on and near the hills, and there was more or less cloud everywhere, but still there was no rain except a few drops at Delhi.

30th April.

STATION.	Pressure at 8 A. M.	Change since previous day.	TEMPERATURE.			WIND.		Humidity 8 A. M.	Cloud 8 A. M.	Rainfall.	Weather Remarks.
			8 A. M.	Maximum.	Minimum.	Direction.	Mean Velocity.				
Simla ...	23.077	-.067	60.8	72.5	50.0	N. E.	...	52	6	0.48	Strong wind. Distant lightning. Fine.
Chakrata ...	23.110	-.069	60.6	74.3	48.2	E.	10	54	10	0.14	
Mussooree...	23.264	-.070	63.0	74.0	52.5	N. E.	20	44	8	...	
Ranikhet ...	23.934	-.080	66.6	76.5	58.0	C	8	55	5	...	
Lahore ...	29.457	-.148	86.2	101.6	68.5	S. S. E.	1	36	2	...	Thunder storms. with hail.
Ludhiana ...	29.476	-.110	86.7	105.3	76.6	C.	...	31	8	...	
Roorkee ...	29.566	-.056	80.8	103.6	71.1	S.	3	59	4	0.18	
Meerut ...	29.574	-.071	82.4	106.2	73.9	N. E.	3	58	2	...	
Bareilly ...	29.570	-.071	82.9	104.3	73.0	S. E.	5	53	3	...	Dust storm. Hot wind. Dust haze.
Gorakhpur...	29.626	-.066	71.3	99.8	66.8	S.	5	88	5	0.86	
Ajmere ...	29.600	-.066	83.8	103.3	80.5	W.	14	51	5	...	
Jeypore ...	29.600	-.061	85.6	106.6	75.4	N. W.	7	30	7	...	
Agra ...	29.568	-.056	88.2	109.5	81.9	S. E.	7	45	3	...	Dust haze. Distant lightning.
Lucknow ...	29.590	-.083	82.7	105.3	74.8	E.	5	50	3	...	
Allahabad ...	29.623	-.014	84.3	105.1	81.6	E.	5	55	6	...	
Benares ...	29.637	-.018	80.6	106.8	79.0	N.	6	64	7	...	
Patna ...	29.680	-.067	69.5	97.0	69.7	N. N. E.	9	95	10	...	Dust haze. Dust storm. Dust haze.
Gya ...	29.619	-.072	88.2	101.5	75.3	C.	5	57	8	0.01	
Sutna ...	29.578	-.038	95.2	107.7	85.5	W. S. W.	12	18	4	...	
Nowgong ...	29.576	-.065	93.8	108.1	85.7	W.	6	20	3	...	
Jhansi ...	29.552	-.138	93.7	109.5	90.9	W.	6	26	

On the morning of the 30th there was a still further fall of pressure, especially in the Punjab, but the distribution remained almost unaltered, and resembled that which obtains about the beginning of the rainy season. The winds were easterly over the hills and the whole of the country north of the Ganges. The changes of humidity were various,

but the sky was generally clouded. Slight rain had fallen on the hills the previous evening and there had been a thunderstorm with hail at Roorkee.

1st May.

STATION.	Pressure at 8 A. M.	Change since previous day.	TEMPERATURE.			WIND.		Humidity 8 A. M.	Cloud 8 A. M.	Rainfall.	Weather Remarks.
			8 A. M.	Maximum.	Minimum.	Direction.	Mean Velocity.				
Simla ...	23.099	+ .022	52.0	70.1	49.5	S. E.	...	70	8	0.38	Drizzling.
Chakrata ...	23.175	+ .065	47.4	73.8	46.2	E.	51	90	10	0.36	
Mussooree ...	23.330	+ .065	48.5	73.5	47.0	N. N. E.	20	87	10	0.59	Thunder storm.
Ranikhet ...	24.077	+ .143	51.5	75.5	50.0	E.	8	92	10	0.61	Raining.
Lahore ...	29.415	- .042	84.2	101.1	73.4	S. W.	7	34	10	...	Dust storm.
Ludhiana ...	29.514	+ .038	80.7	99.3	78.1	S.	3	43	...	...	"
Roorkee ...	29.711	+ .145	70.3	98.6	67.7	E.	5	74	9	0.26	Distant lightning.
Meerut ...	29.677	+ .103	75.9	101.3	67.0	N. E.	6	71	...	0.30	Dust storm.
Bareilly ...	29.689	+ .119	78.9	102.8	70.5	E. S. E.	9	61	2	0.15	
Garakhpur ...	29.751	+ .125	78.2	87.3	73.8	E.	6	72	1	...	Strong wind.
Ajmere ...	29.651	+ .051	79.8	101.3	77.6	W.	17	65	...	...
Jeypore ...	29.625	+ .025	85.6	105.1	81.4	W.	6	43	...	...	Dust haze.
Agra ...	29.645	+ .077	85.2	107.5	79.9	S. E.	9	49	2	...	Dust haze.
Lucknow ...	29.714	+ .124	80.7	104.8	75.8	E.	5	68	...	...
Allahabad ...	29.715	+ .092	83.3	105.1	78.1	E.	8	62	...	...	Showery.
Benares ...	29.732	+ .095	79.1	103.3	75.5	E.	7	72	...	...
Patna ...	29.735	+ .055	79.6	87.4	72.2	E.	7	78	...	0.03	Strong wind.
Gya ...	29.739	+ .120	84.2	99.0	72.8	N.	11	63	4	...	
Sutna ...	29.686	+ .108	92.2	107.2	80.6	W. N. W.	15	23	...	...	Hot wind.
Nowgong ...	29.686	+ .110	89.3	107.1	83.2	W.	7	30	...	...
Jhansi ...	29.643	+ .091	88.6	110.5	86.4	S. W.	8	41	...	...

A rapid rise of pressure had now taken place over the whole region except in the Punjab. The gradients were steeper than usual and the winds strong. Easterly winds continued over the same region as before. Temperature was still very high in Bundelkhand, but had fallen elsewhere. Many dust-storms were reported with slight rain.

2nd May.

STATION.	Pressure at 8 A. M.	Change since previous day.	TEMPERATURE.			WIND.		Humidity 8 A. M.	Cloud 8 A. M.	Rainfall.	Weather Remarks.
			8 A. M.	Maximum.	Minimum.	Direction.	Mean Velocity.				
Simla ...	23 179	+ .080	57.5	63.0	55.1	S. E.	...	52	9	...	Dust haze.
Chakrata ...	23 243	+ .068	55.6	57.8	49.2	E.	12	77	10	0.56	Strong wind.
Mussooree...	23 394	+ .064	59.0	55.0	46.5	S. S. E.	13	76	4	1.04	Hail Storm.
Ranikhet ...	24 081	+ .004	58.6	63.2	49.0	C.	8	73	4	0.73	Threatening.
Lahore ...	29 680	+ .265	75.1	88.1	65.6	C.	11	56	10	...	Dust storm.
Ludhiana ...	29 698	+ .184	81.2	90.2	78.1	S.	7	45	...	...	"
Roorkee ...	29 753	+ .042	75.8	82.6	69.7	S.	4	62	4	0.35	Distant lightning.
Meerut ...	29 764	+ .087	77.9	82.2	69.0	S. E.	5	63	8	0.18	"
Bareilly ...	29 755	+ .066	82.4	92.1	72.0	E. S. E.	9	52	2	0.10	"
Gorakhpur...	29 756	+ .005	79.7	92.8	73.3	E. S. E.	5	74	...	...	"
Ajmere ...	29 776	+ .125	81.3	98.8	72.6	S. W.	11	32	...	...	Dust haze.
Jeypore ...	29 775	+ .150	81.6	102.1	74.9	N. N. W.	10	25	...	...	"
Agra ...	29 743	+ .098	85.2	104.5	77.0	E.	8	51	...	...	Hot wind.
Lucknow ...	29 750	+ .036	86.6	102.3	76.3	S. E.	6	50	...	...	Dust storm.
Allahabad ...	29 747	+ .032	88.3	105.6	80.6	S. S. E.	6	66	...	...	Dust haze.
Benares ...	29 737	+ .005	84.4	103.8	80.4	E.	6	70	...	...	"
Patna ...	29 748	+ .013	85.6	97.0	76.7	C.	7	72	...	...	"
Gya ...	29 762	+ .023	86.2	102.0	76.8	N. E.	5	68	...	...	"
Sutna ...	29 759	+ .073	93.2	106.2	76.6	W.	13	19	...	...	"
Nowgong ...	29 754	+ .068	89.8	105.1	75.6	W.	2	33	...	...	Hot wind.
Jhansi ...	29 731	+ .088	89.6	106.6	85.9	S. S. W.	8	41	...	...	"

There was a further very large increase of pressure over the whole region, especially in the Punjab, where it exceeded a quarter of an inch. The barometric depression in the Punjab had nearly filled up and a secondary depression had appeared in the eastern districts of the N.-W. Provinces. The winds were still easterly along the foot of the Himalaya, and very strong easterly winds had been blowing at the hill stations the previous afternoon. A great fall of temperature had taken place since the previous day and many dust-storms with rain had occurred. Hail had fallen at Mussooree and Delhi. On the 3rd a further fall and redistribution of pressure took place with the effect that westerly winds again set in over the whole region.

These observations indicate that, from the 26th April to the end of the month, there was a steady influx of moist air from the east over the northern half of the Gangetic plain and the outer Himalaya; that during this time there was a constant high temperature over the regions

to the south of the Ganges and Jumna; whilst from the 28th onwards the barometer fell steadily, so that on the morning of the 30th it stood unusually low, especially in the Punjab. Something then occurred to cause a rapid fall of temperature and rise of pressure, so that on the morning of the 2nd May the distribution of pressure was greatly altered, and its absolute value everywhere much higher than on the 30th, whilst the temperature at the northern stations had fallen many degrees. To account for these changes the morning observations show only a few dust-storms with hail in one or two places. There had been in the interval several violent tornadoes; but as none of them (except one which passed over Delhi) went near any of the meteorological observatories, the daily reports give little or no indication of their occurrence.

The weekly reports of rainfall compiled by the district officers also throw very little light on the origin or progress of these storms. They only record the quantity of rain which fell, or, in the case of hail, the quantity which happened to remain and get melted in the funnel of the gauge. When hail falls with great velocity and rebounds to a considerable height, the part which is caught and melted in the gauge is evidently always much less than the total quantity which falls into it, and bears no constant relation to what falls.

The district returns of rainfall for the Meerut, Rohilkhand, Kumaon, and Sitapur divisions for the four days from the 29th April to the 2nd May, inclusive, are as follows (the rainfall is recorded at 6 P. M., any which falls after that hour being included in the total for the next day):

Division.	District.	Station.	APRIL.		MAY.		Total.
			29th.	30th.	1st.	2nd.	
Meerut.	Dohra Dun	Mussooree ..	...	0 40	1 27	...	1 67
		Kalsi ..	...	...	...	1 10	1 10
		Dehra ...	...	0 14	0 54	...	0 68
		Chakrata ...	...	0 11	0 36	0 56	1 06
		Ambari ...	...	0 20	0 70	...	0 90
		Bhogpur ...	...	...	0 70	...	0 70
		Saharanpur ...	...	0 40	0 50	...	0 90
		Roorkee ...	...	...	0 80	...	0 80
	Saharanpur	Nakur ...	...	...	0 10	...	0 10
		Dooband ...	...	...	0 70	...	0 70
		Hardwar ...	...	0 35	0 45	...	0 80
		Muhammadpur ...	...	0 10	0 80	...	0 90
		Naihashahr ...	...	...	...	...	...
		Jarauda ...	...	...	...	...	...
		Shamli ...	...	...	0 20	0 70	0 90
		Budhana ...	...	0 10	...	...	0 10
	Muzaffarnagar	Muzaffarnagar ...	...	1 05	0 30	...	1 35
		Jaoli Jansath ...	...	1 80	0 20	...	2 00
		Bhainswal ...	...	...	...	...	...
		Kandhla ...	...	...	...	...	...

Division.	District.	Station.	APRIL.		MAY.		Total.
			29th	30th	1st	2nd	
Meerut (concluded).	Meerut	Sardhana ...	...	...	0 30	...	0 30
		Meerut ...	...	...	0 30	...	0 30
		Mawana ...	...	...	0 20	...	0 20
		Bagpat ...	...	...	0 60	...	0 60
		Ghaziabad ...	...	...	...	...	...
		Hapur ...	...	...	0 30	...	0 30
	Bulandshahr	Garhmukhtesar ...	...	...	0 10	...	0 10
		Sikandarabad ...	...	...	...	...	...
		Bulandshahr ...	...	...	...	...	...
		Anupshahr ...	...	...	...	...	...
		Khurja ...	...	...	...	...	...
		Narora ...	...	...	...	...	...
	Aligarh	Dayanatpur ...	...	...	...	...	...
		Khair ...	...	...	...	...	...
		Aligarh ...	...	...	...	...	...
		Atrauli... ..	...	...	...	...	...
		Igles ..	...	...	...	...	...
		Hathras ...	...	...	...	...	...
Rohilkhand.	Bijnor	Sikandra Rao ...	...	...	...	...	...
		Balanpur ...	...	...	...	...	...
		Bijnor ...	...	0 53	0 30	0 10	0 98
		Nagina ..	...	...	0 90	...	0 90
		Dhampur ...	...	0 10	0 20	...	0 30
		Najibabad ...	...	...	0 70	...	0 70
	Moradabad	Chandpar ...	...	0 60	2 50	...	3 10
		Thakurdwara ...	...	...	1 40	...	1 40
		Moradabad ...	...	...	1 15	...	1 15
		Amroha ...	...	...	0 20	...	0 20
		Hasanpur ...	...	...	0 30	0 90	1 20
		Sambhal ...	...	...	...	...	...
	Pilibhit	Bilhari ..	...	...	...	...	...
		Pilibhit (City) ...	...	0 30	0 40	...	0 70
		Pilibhit (Kutchery) ...	...	0 27	0 36	...	0 63
		Bisalpur ...	...	0 10	0 20	...	0 30
		Puranpur ...	...	0 10	0 14	...	0 24
		Amaria... ..	...	0 30	0 30	...	0 60
Rohilkhand (concluded).	Bareilly	Mirganj ...	...	...	...	...	...
		Nawabganj ...	...	0 80	2 10	...	2 90
		Aonla ...	...	...	1 50	...	1 50
		Bareilly ...	...	...	0 10	...	0 10
		Karor ..	...	...	0 18	...	0 18
		Faridpur ...	...	...	0 70	...	0 70
	Budaun	Baheri ..	...	0 10	0 70	...	0 80
		Bisauli ...	...	...	1 10	...	1 10
		Gunnaur ...	...	...	...	...	...
		Sahaswan ...	...	...	...	...	...
		Budann ...	...	...	...	...	...
		Dataganj ...	...	...	0 85	...	0 85
	Shahjahanpur	Pawayan ...	...	...	...	...	...
		Tilhar ...	...	1 50	...	...	1 50
		Shahjahanpur ...	...	1 56	...	...	1 56
		Jalalabad ...	...	...	...	...	...

Division.	District.	Station.	APRIL.		MAY.		Total.
			29th	30th	1st	2nd	
Kumaun.	Kumaun	Champawat ...	0·28	2·40	...	...	2·68
		Pithoragarh ...	0·05	0·69	0·78	0·17	1·69
		Almora ...	0·17	0·40	1·20	0·26	2·03
		Naini Tal ...	0·30	1·10	2·40	...	3·80
		Haldwani ...	0·50	1·60	...	...	2·10
		Ranikhet Obsry. ...	...	0·16	1·23	0·11	1·50
	Garhwal	Treasury ...	0·29	...	0·94	0·43	1·66
		Pauri ...	...	...	0·92	0·12	1·04
		Srinagar ...	...	0·70	0·70	0·10	1·50
		Budarpur ...	...	0·60	0·70	...	1·30
Sitapur.	Tarai	Kilpuri ...	...	...	0·20	...	0·20
		Kashipur ...	...	0·10	0·90	0·10	1·10
		Satarganj ...	...	0·10	0·30	...	0·40
	Sitapur	Sitapur ...	...	...	0·56	...	0·56
		Biswan ...	...	...	...	0·50	0·50
		Sidhauli ...	...	...	...	...	...
	Hardoi	Misrikh ...	...	...	...	...	...
		Hardoi ...	...	...	...	...	...
		Shahabad ...	...	...	...	...	...
		Sandila ...	...	...	...	...	...
Kheri	Kheri	Bilgram ...	...	...	...	...	...
		Kheri ...	0·07	...	0·04	...	0·11
		Muhamdi ...	...	...	0·20	...	0·20
		Nighasan ...	...	...	...	...	...

The disturbances which produced rain or hail on the 30th April and 1st May were thus pretty general over all the north-western districts of the N.-W. Provinces, but in most places they were of an ordinary character like the thunder-storms which frequently occur in the hot weather months. The storms which were of tornado-like violence and destructive to human life were much more limited in their scope, as may be seen from the district reports and newspapers.

NUMBER, TIMES OF OCCURRENCE, DURATION AND PATHS OF THE TORNADOES OF THE 30TH APRIL AND 1ST MAY.

On hearing of the violence of the Moradabad storm and of the occurrence of the same storm, or others nearly coincident with it, in the surrounding districts, I issued a circular to the chief civil officers of Meerut, the Tarai, and all the districts of the Rohilkhund Division. The circular and the replies are printed in the Appendix. Of the Delhi storm I have received no local reports except those which appeared in the newspapers, some cuttings from which are also appended.

The somewhat conflicting evidence of these reports regarding the time at which the storm visited each place may be summarized as follows :—

I. Storm of 30th April.

Place.	District.	Time of occurrence.	Character of Storm.
Gunnaur ...	Budaun.	6 P. M.	Slight, without precipitation.
Sahaswan ...	Do.	6 P. M.	Slight, with small hail.
Budaun ...	Do.	6 P. M.	Moderate, with hail.
Hapur ...	Meerut.	4-5 P. M.	Slight, with small hail.
Mawana ...	Do.	8-10 P. M.	Severe, with hail.
Meerut ...	Do.	6 P. M.	Slight dust storm only.
Amroha ...	Moradabad	Evening.	Slight, with hail.
Moradabad ...	Do.	6 P. M.	Most destructive, very severe hail-storm.
Thakurdwara ..	Do.	Evening.	Slight, with hail.
Baheri ...	Barielly.	6-8 P. M.	Destructive, heavy hailstorm, several men killed.
Nawabganj ...	Do.	7-9 P. M.	Ditto. ditto.
Bisalpur ...	Pilibhit.	10-12 P. M.	Severe, with large hailstones.
Puranpur ...	Do.	7-10 P. M.	Slight with hail.
Several places ...	Bijnar. .	Evening.	Very slight, with hail in places.

From this summary, taken in connexion with the rather indefinite ideas of time possessed by the native tahsildars on whose statements it is founded, it appears that there were at least three distinct storms of the character of tornadoes over the Rohilkhand plain on the afternoon and evening of the 30th April, not to mention the hailstorms which occurred the same day at Naini Tal, Mussooree, and other places on the hills.

(1.) The Moradabad tornado, appears to have originated or been first felt near the ground, in the vicinity of Hapur, the southern tahsil of the Meerut district, between 4 and 5 P. M. Thence it proceeded eastwards, gradually increasing in intensity, passing to the south of Amroha and striking Moradabad with full force about 15 minutes past 6. It then crossed the Rampur State, reaching Baheri and Nawabganj in Bareilly about 8 P. M. and being still of destructive violence. Afterwards it passed eastwards across the Pilibhit district to the border of Kheri, which it probably reached between 9 and 10 P. M., the violence of the storm at the same time gradually abating. Its course, shown on both the charts for the 30th April, was about 150 miles in length and the time occupied in traversing it about 5 hours. The velocity of translation was thus something like 30 miles per hour. Regarding the time of passage of the central most violent region over any given point no exact data are obtainable. The Collector of Moradabad estimates it at 15 or 20 minutes, but says, "It is of course not easy to determine the exact point of time when the storm stopped." The breadth of the strip of country over which the trees were blown down

does not seem to have been anywhere quite a mile, and if this be accepted as the diameter of the dangerous area, the duration of the destructive wind, with the above-mentioned rate of progression could not much exceed two minutes.

(2.) The Mawana storm was a small one occurring late in the evening. It passed eastwards, crossing the Ganges into the south of the Bijnor district, and the north of Moradabad (Thakurdwara). It may have originated in the afternoon and crossed over into the Doab from the districts west of the Jumna, but I have no information on this point.

(3.) The Budaun storm, also of no great importance, probably travelled nearly from west to east along a path stretching from Gunnaur to the north of the Budaun tahsil, parallel to, and simultaneously with, the Moradabad storm. Regarding the time of occurrence there is, however, a conflict of opinion; it is stated to have occurred later at Gunnaur than at Budaun. If this be so, it must have travelled from east to west in a contrary direction not only to the other storms of the same and following days but contrary also to the usual course of all tornadoes which have been observed, at least in extratropical countries.

The probable courses of (2) and (3) are shown on the charts, but there is no means of determining the whole distance traversed or the velocity of progression.

II. *Storms of the 1st May.*

Place.	District.	Time of occurrence	Character of Storm.
Delhi ...	Dolhi.	3-4 P. M.	Destructive, enormous hailstones.
Ghaziabad ...	Meerut.	Afternoon.	Ditto. ditto.
Sambhal ...	Moradabad.	Evening.	Slight.
Hasanpur ...	Do	Do.	Slight.
Jaintipur ...	Shajahanpur.	2-3 P. M.	Very destructive with hail.
Tilhar ...	Do.	3 P. M.	Ditto. Hailstones enormous.
Shahjahanpur ...	Do.	4-5 P. M.	Destructive, hail moderate.
Dataganj ...	Budaun.	4 P. M.	Moderate with hail.

The above table shows that there were at least two violent storms over the region on the afternoon of the 1st May, one of which passed over Delhi and Ghaziabad and the other over Tilhar and Shajahanpur.

(1.) The Delhi storm apparently approached that city from the west or north-west, passed over Delhi about half-past 3 in the afternoon, crossed the Jumna to Ghaziabad, where it was still of extreme violence and accompanied by enormous hailstones, and in the course of evening, time not stated, reached the Sambhal and Hasanpur tahsils

of Moradabad district, but died out before reaching Bilari. The distance from Delhi to Sambhal is about 85 miles and the whole course of the storm was probably not less than 100 miles. As the times of its passage are not exactly stated, no estimate can be made of its rate of progression. The breadth of the belt of country damaged by it is estimated by the *Pioneer* correspondent at 2 miles.

(2.) The Tilhar storm commenced near Datoganj in the eastern part of Budaun district probably about 2 P. M., though the local report from Datoganj says 4 P. M. It passed over Jaintipur about 2-30, and Tilhar at 3 or 3-30 P. M., reaching Shahjahanpur between 4 and 5 P. M., its intensity at the same time gradually diminishing. Beyond Shahjahanpur it has not been traced as a violent storm, but the disturbance probably passed into Sitapur district and was the occasion of same rainfall there. If the assumed time of commencement be correct, this storm took about $2\frac{1}{2}$ hours to travel from Datoganj to Shahjahanpur, a distance of about 35 miles; or if we may suppose that the times assigned to its passages over Datoganj and over Jaintipur and Tilhar are equally erroneous, the one being as much too early as the other is too late (an assumption which would make the time of its passage over Tilhar agree with the statement of the *Pioneer* correspondent), the time occupied in passing over this distance would be about an hour less. In the one case the velocity of translation would be 14 miles an hour, and in the other 23, both of which estimates are considerably less than the velocity found for the Moradabad storm. No exact details of the breadth of country affected by the storm or of the duration of its passage have been received.

In these estimates of the rate of progression of the several disturbances mentioned, it is assumed that the destructive tornado and the much more widely felt hailstorm are identical. This assumption is open to question, but I know of no criterion by which the two phenomena can be satisfactorily distinguished. It seems to me that a tornado is only a violent whirlwind which reaches to the ground, whilst an ordinary thunderstorm or a hailstorm may be quite as intense in its gyratory motion as a tornado, but at some level considerably above the ground.

DIRECTION AND FORCE OF THE WIND IN THESE STORMS.

The reports all agree in stating that the storms commenced with a strong west wind which unroofed houses, uprooted trees, and did damage in various other ways, and that after a short time the wind shifted to North-West, or North, at the same time slacking considerably. In one or two cases a further veering to North-East or East is reported. though, after the storm was over, the wind again blew from the west.

There can be no doubt, therefore, that as in the case of the 600 tornadoes in the United States investigated by Finlay, the wind blew in whirls according to the usual law of cyclonic circulation for the northern hemisphere; but the whirling movement was combined with a rapid movement of translation from West to East which had the effect of greatly increasing the velocity of the westerly currents blowing on the south side of the centre, and partially or completely annulling that of the easterly currents on the north side. The velocity of the wind in the Moradabad storm has been roughly estimated at 60 miles per hour. If this be accepted as the velocity of rotation, the actual velocity of the west winds must have been about 90 miles, and of the easterly ones only 30 miles per hour.

It is greatly to be regretted that in none of the storms mentioned was any competent European officer able to devote his time to the local investigation of the direction and force of the wind, by the examination of its destructive effects on buildings and trees, a task which has been so ably performed by Dr. Crombie in the case of the Dacca tornado. It is also to be regretted that no local meteorological observations are forthcoming; though, as Mr. Mackintosh, the Collector of Moradabad, very justly remarks, when people's roofs have been carried off, or are tumbling in, the circumstances are not conducive to the taking of correct observations.

Except at Moradabad no estimate has been made of the velocity of the wind. The Collector of Bareilly estimates its pressure at Baheri and Nawabganj during the passage of the Moradabad storm at 28 lbs. to the square foot, which would correspond to a velocity of about 75 miles an hour, and is probably not far from the truth. At Tilhar, the force must have been very considerable. Trees were blown to distances of 10 or 15 yards, and roofs were carried 25 or 30 yards. For the Budaun storm the tahsildars give curious and fanciful estimates of the wind's force, which at one place was considered equal to the strength of 3 elephants and in another to 16 horses combined. One curious effect of the pressure of the wind is given by the Moradabad correspondent of the *Civil and Military Gazette*. A train of empty goods waggons, standing on a siding at Moradabad station, was blown along the line to a distance of nearly two miles, where it came into collision with a strong bullock, and whether owing to this accident or to a shift of the wind's direction it was there derailed, and tore up the line for a considerable distance.

As regards ascending currents near the centre of the tornado, the Moradabad report indicates the probability that there was a strong aspiration in an upward direction. The way in which the verandahs

of the Collector's house were "shorn away," and the massive masonry portico dislodged by the wind, as well as that in which the roofs of houses were lifted bodily off and carried to a distance, are hardly explicable except on the assumption of a powerful upward component in the wind's motion.

ELECTRICAL PHENOMENA.

Except at Delhi, the existence of thunder and lightning in connexion with the storm is not expressly mentioned; for by an oversight, no direct inquiry was made regarding this point in my circular. I have been privately informed, however, by a resident of Moradabad, that the tornado commenced there also as a thunderstorm, and there can be little doubt that as in almost every case investigated by Finley in the United States, all these storms were accompanied by electrical disturbances. No casualties from lightning are mentioned except the death of one man in the Bareilly district.

HAIL.

At every place without exception, from which anything like a full account of the local storm has been received, hail is reported. In many instances, the fall was light and the hailstones were small, not larger than a "grown seed," that is, about as big as a pea, and similar to what falls in ordinary hailstorms. In the Moradabad storm, however, the quantity of hail and the velocity with which it fell seems to have been enormous, though the size of the hailstones was not great, not larger than a pigeon's egg. The hail which accompanied the same storm in its passage over the Bareilly district later in the evening was of a similar character, the average weight of the hailstones being about an ounce ($\frac{1}{3}$ chittack). The extraordinary thing about this hail was its fatal effect upon human beings. It is difficult to believe that over 230 people could have been killed in one district and 16 in another by showers of ice pellets no bigger than boys' marbles; but such would seem to have been undoubtedly the case. The Collector of Moradabad reports that men caught in the open and without shelter were simply "pounded to death" by the hail. The hailstones were therefore probably falling from such a height that they approached the ground with a velocity in something approaching to the same order of magnitude as that of a rifle bullet. It should be borne in mind, however, that immediately before the storm, the temperature had been very high, and that many, if not the majority, of the deaths due to it may have been occasioned by the persons exposed to its fury being knocked down and temporarily packed in ice. The shock to the system, especially of a

thinly clad native of India, under such circumstances, would probably in many cases be sufficient to cause death. At Bisalpur in Pilibhit district some of the hailstones are said to have been $\frac{3}{4}$ seer ($1\frac{1}{2}$ lb) in weight, but these must have been aggregates of many individual stones. At Puraupur they were the size of plums, that is to say, about the same size as at Moradabad.

The hail which fell on the 1st May, though less fatal to human life, owing to the longer warning given of its approach, consisted of very much larger stones. The Delhi correspondent of the *Pioneer* vouches for one stone as much as two pounds in weight, though this was doubtless an aggregate of several smaller ones; for the writer says that for two minutes the fall presented the appearance of a shower of lumps of ice. The stone as big as a man's fist and weighing $2\frac{1}{4}$ chittacks ($4\frac{1}{2}$ ounce) picked up by the same observer may have been a single one, for the occurrence of such is confirmed by a writer in the *Civil and Military Gazette*, who says that at Ghaziabad many hailstones as large as cricket balls fell. The form of the stones was a "flat oval" probably like the disc or button shape often observed in smaller hailstones. Many persons are said to have been cut and wounded by these large hailstones, and at least one was killed outright, having his head split open. At Tilhar the hailstones which fell the same afternoon appear to have been almost equally large. The Assistant Collector says they were larger than goose eggs at Tilhar, while, in the west of the tahsil, they averaged nearly 3 inches in diameter. The *Pioneer* correspondent, a European gentleman who was in camp near Tilhar, says, however, they were only as large as turkey's eggs. They were probably not spherical, and three inches was perhaps about their longest dimension, instead of the mean diameter.

Finlay has found (*Professional Papers of the Signal Service, No. VII*) that, out of 192 cases of tornadoes accompanied by hail in the United States, the hail preceded the tornado in 135 cases, followed it in 76, and coincided with it in 4 cases. In these Indian storms the hail seems in all cases to have occurred either simultaneously with the most violent phase of the storm or after its first fury had passed. From the Moradabad report it appears that the "hurricane" and hail occurred simultaneously. In the Tilhar storm, at every place where it was observed, the first and most violent wind came from the west and afterwards it suddenly veered to the north, when the hail commenced. At Jaintipur there was a distinct pause between the two gusts of violent wind, probably coincident with the passage of the actual centre of the storm. The hail seems therefore to have fallen chiefly over the western half of the area affected by the storm at any given instant.

DESTRUCTION OF LIFE AND PROPERTY.

By far the most destructive of these storms was that which passed over Moradabad. Over 230, and probably close upon 250, people were killed in Moradabad alone, chiefly by the hail. Sixteen men were killed by hail, one by lightning, and 7 by falling trees and other causes in the Bareilly district, and 5 men are reported as killed in Pilibhit. The casualties thus amounted to about 280 in all, not counting any which may have occurred in the native state of Rampur, over which the storm passed.

In the Tilhar storm only about a dozen men were killed altogether, and the number of fatal cases at Delhi was about the same.

The damage done to crops and trees has been variously estimated, and probably but little reliance can be placed on any of the reports regarding this point. The estimates of the value of animals killed and buildings injured or destroyed are more trustworthy. At Moradabad, where by far the greatest destruction of property as well as of life took place, the total damage done is estimated by the Collector at Rs. 100,000.

RELATIONS OF THE TORNADOES TO OTHER METEOROLOGICAL PHENOMENA.

Under the head of general weather it has been stated that, for several days preceding these storms, there had been a steady influx of moist easterly winds into the area affected by them, and that latterly this was combined with a general fall in the barometer, whilst after the storm there was a rapid increase of pressure, and west winds set in again over the whole region. There may, therefore, have been some direct and obvious connexion between the distribution of pressure and the genesis of the storms, though the observations made at 8 A. M., when the air is still undisturbed by the convection currents set up by the daily action of the sun, do not show this connexion clearly. At all the stations mentioned in the preceding tables, and at several others in the same region, meteorological observations were made at 10 A. M. and 4 P. M., as well as at 8 A. M. The principal observations made at these hours on the 29th and 30th April and the 1st and 2nd May are here given, the actual pressures as well as their values at sea-level being shown. For the hill stations the latter are of course very doubtful, and in reality have no meaning whatever; but the region affected by the storm lies so close to the hills that its relation to the general trend of the isobars could not be properly shown without extending these over a part of the mountain region. In reducing the observations of the hill stations to sea-level, the temperature has been assumed to increase downwards, or

to diminish upwards, at the following rates, which have been determined from observations in the day time in the month of May in North-Western India, and are given at p. 358 of a paper on the *Winds of Northern India*, published in the *Phil. Trans.*, Vol. 178.

<i>Height.</i>	<i>Temperature Decrement.</i>
Sea-level to 1,000 ft.	7·3°
1,000 to 2,000 „	6·1 „
2,000 to 3,000 „	5·1 „
3,000 to 4,000 „	4·1 „
4,000 to 5,000 „	3·2 „
5,000 to 6,000 „	2·3 „
6,000 to 7,000 „	1·5 „
7,000 to 8,000 „	0·8 „

Some of the barometric observations appear to be in error to the extent of a tenth or a twentieth of an inch. These are marked with a note of interrogation.

29th April, 1888.

Stations.	Elevation.	10 A. M.				4 P. M.				Rainfall.		
		Pressure observed.	Pressure at sea level.	Temper- ature.	Humi- dity.	Wind Direc- tion.	Pressure observed.	Pressure at sea level.	Temper- ature.		Humi- dity.	Wind direc- tion.
Simla	7048.24	23.160	29.550	68.0	40	S. W.	23.128	29.496	69.4	.34	S. W.	...
Chakrata	7051.58	23.188	29.557	70.6	33	W.	23.158	29.499	72.1	31	E.	...
Mussooree	6881	23.346	29.582	71.0	39	S. S. E.	23.285	29.538	68.3	49	S.	...
Ranikhet	6068.75	24.017	29.578	72.8	39	W.	23.966	29.532	71.3	48	S. W.	...
Pithoragarh	5368.20	24.650	29.612	76.1	46	C.	24.546	29.443	80.5	38	S. W.	...
Katmandu	4387.8	25.619	29.892	62.4	93	S. W.	25.511	29.761	62.9	85	S. W.	...
Ludhiana	811.86	28.782	29.510	95.8	25	C.	28.679	29.466	99.4	21	C.	0.72
Dehra	2233.00	27.463	29.609	87.2	27	S. S. E.	27.383	29.514	89.7	29	W. S. W.	...
Roorkee	886.63	28.747	29.609	95.2	28	S. E.	28.621	29.472	99.2	29	C.	...
Barailly	568.47	29.074	29.631	93.1	46	S. E.	28.925	29.470	102.0	26	C.	...
Gorakhpur	255.93	29.425	29.681	90.3	52	S. S. E.	29.301	29.551	99.0	40	C.	...
Durbhanga	166.32	29.566	29.737	82.5	73	E. N. E.	29.418	29.586	87.5	63	E. N. E.	...
Lahore	702.22	28.904	29.597	94.0	36	N. W.	28.789	29.472	99.2	27	N. E.	...
Sirsa	661.61	28.920	29.570	96.2	41	C.	28.788	29.424	105.5	28	W.	...
Sambhar	1253.52	28.408	29.633	91.4	35	W. S. W.	28.283	29.479	101.8	17	W.	...
Jeypore	1430.60	28.246	29.630	94.7	33	W. S. W.	28.125	29.479	104.4	15	N. W.	...
Meerut	737.48	28.899	29.620	92.7	50	N. E.	28.757	29.463	101.3	39	C.	...
Delhi	717.81	28.927	29.705 ?	93.2	38	N.	28.865 ?	29.560 ?	104.2	28	E.	0.02
Agra	555.44	29.071	29.610	98.8	28	W.	28.924	29.450	108.1	15	N. W.	...
Lucknow	369.39	29.314	29.679	93.0	46	N. W.	29.175	29.530	105.4	28	S. S. E.	...
Allahabad	349.28	29.332	29.636	96.1	35	S. E.	29.204	29.501	105.1	20	W. N. W.	...
Benares	266.97	29.365	29.630	93.8	41	E.	29.237	29.493	105.3	17	N. W.	...
Ghazipur	219.74	29.443	29.660	94.8	45	S. E.	29.296	29.509	101.3	34	C.	...
Panna	182.84	29.564	29.749	90.6	58	E.	29.391	29.492	95.7	44	N. E.	...
Gya	374.9	29.296	29.663	94.7	48	E. N. E.	29.112	29.477	102.7	39	E. N. E.	...
Sutna	1040.20	28.598	29.601	101.0	14	W.	28.465	29.479	104.5	14	W. N. W.	...
Nowgong	757.04	28.895	29.626	100.4	19	W.	28.772	29.492	104.9	19	W.	...
Jhansi	840.13	28.871	29.691	99.9	17	N. W.	28.692	29.497	106.9	15	N. N. W.	...
Neemuch	1639.36	28.080	29.672	92.1	41	W.	27.962	29.513	104.1	21	W.	...
Ajmere	1611	28.078	29.643	90.3	47	W.	27.969	29.493	102.4	30	W.	...

30th April, 1888.

Stations.	Elevation.	10 A. M.				4 P. M.				Rainfall.		
		Pressure observed.	Pressure at sea level.	Temperature.	Humidity.	Wind direction.	Pressure observed.	Pressure at sea level.	Temperature.		Humidity.	Wind direction.
Simla	7048.24	23.132	29.581	63.3	54	S. E.	23.098	29.633	56.3	72	N. W.	0.63
Chakrata	7051.58	23.131	29.510	68.5	49	E.	23.073	29.516	62.7	62	S. E.	0.14
Mussooree	6881	23.288	29.529	69.2	44	C.	23.235	29.514	65.3	58	S.	0.40
Bankhet	6068.75	23.967	29.545	70.3	47	C.	23.906	29.458	71.3	49	S. W.	0.16
Pithoragarh	5368.20	24.623	29.609	73.4	49	C.	24.548	29.499	75.2	49	S. W.	0.03
Karnaudn	4387.8	25.554	29.799	64.4	88	N. W.	25.474	29.606	76.4	54	W.	...
Ludhiana	811.86	28.695	29.489	94.8	24	S. E.	28.586	29.375	94.3	24	S. E.	...
Dehra	2233.00	27.404	29.562	83.1	29	E. N. E.	27.340	29.467	89.6	32	S. E.	...
Roorkee	886.63	28.700	29.570	89.3	39	S. E.	28.584	29.444	93.2	35	S. E.	0.18
Bareilly	568.47	29.033	29.591	92.1	113	S. E.	28.918	29.465	99.8	28	S. E.	...
Gorakhpur	255.93	29.377	29.638	79.2	72	E.	29.297	29.554	86.9	63	E.	0.86
Durbhanga	166.32	29.508	29.682	70.5	92	E. S. E.	29.425	29.596	77.4	91	E. S. E.	1.48
Lahore	702.22	28.769	29.490	92.7	30	S. E.	28.625	29.319	88.0	36	N. E.	...
Sirsa	661.61	28.850	29.498	96.9	31	S. W.	28.740	29.380	101.9	27	W.	...
Sambalpur	1253.52	28.338	29.564	89.4	28	W.	28.249	29.448	100.3	19	W. S. W.	...
Jeypore	1430.60	28.203	29.588	93.7	22	N. W.	28.084	29.438	103.5	19	W. N. W.	...
Meerut	737.48	28.835	29.558	90.9	46	N. E.	28.687	29.396	97.7	37	N. E.	...
Delhi	717.81	28.871	29.579	93.2	38	E.	28.820	29.517	101.2	30	E.	...
Agra	555.44	29.033	29.574	96.1	24	S. W.	28.909	29.438	105.3	17	S. W.	...
Lucknow	369.39	29.250	29.615	91.6	38	W. N. W.	29.159	29.515	102.4	23	N. N. E.	...
Allahabad	309.28	29.314	29.622	89.8	49	E. S. E.	29.188	29.484	105.3	23	E.	...
Benares	266.97	29.337	29.624	89.5	51	E.	29.250	29.508	102.3	27	N. W.	...
Ghazipur	219.74	29.431	29.652	86.4	63	E.	29.299	29.514	97.9	43	S. E.	...
Patna	182.84	29.490	29.682	72.5	87	E.	29.396	29.582	85.1	62	E. N. E.	0.03
Gya	374.9	29.254	29.629	90.2	53	E. N. E.	29.154	29.524	95.9	45	E.	0.01
Satna	1040.20	28.566	29.569	100.5	13	W. N. W.	28.461	29.452	105.6	10	W.	...
Nowgong	757.04	23.855	29.585	99.9	17	W.	28.759	29.476	106.9	12	W.	...
Jhansi	840.13	28.760	29.576	100.9	16	N. N. W.	28.669	29.475	105.9	13	S. W.	...
Nannuch	1639.36	28.047	29.645 ?	89.6	29	N. W.	27.955	29.512	102.1	13	W.	...
Ajmere	1611	28.014	29.574	90.3	37	W.	27.983	29.462	99.9	32	W.	...

1st May, 1888.

Stations.	Elevation.	10 A. M.				4 P. M.				Rainfall.		
		Pressure observed.	Pressure at sea level.	Temper- ature.	Humi- dity.	Wind direc- tion.	Pressure observed.	Pressure at sea level.	Temper- ature.		Humi- dity.	Wind direc- tion.
Simla	7048-24	23-136	29-655	58-0	58	S. E.	23-104	29-586	60-2	63	S. E.	0-23
Chakrata	7051-58	23-181	29-879	46-9	93	E. E.	23-120	29-714	52-5	78	E. E.	0-41
Mussooree	6881	23-324	29-865	48-0	86	N. N. E.	23-310	29-763	54-0	75	N. N. E.	1-27
Ranikhet	6068-75	24-085	29-891	53-3	90	E. E.	24-040	29-823	54-4	90	E. C.	1-23
Pithoragarh	5368-20	24-755	29-993	51-6	96	N. E.	24-706	29-901	54-7	92	S. W.	1-36
Katmandu	4387-8	25-634	29-833	71-4	64	N. W.	25-559	29-684	78-9	52	S. W.	0-20
Ludhiana	811-86	28-744	29-561	81-7	44	S.	28-675	29-481	86-7	36	S.	...
Dehra	2233-00	27-500	29-735	66-4	87	N.	27-417	29-621	80-3	40	E. S. E.	0-44
Roorkee	886-63	28-857	29-765	70-3	75	N. E.	28-728	29-610	82-3	42	E. E.	0-61
Bareilly	568-47	29-166	29-743	78-3	68	N. E.	29-086	29-660	79-9	74	C.	0-25
Gorakhpur	255-93	29-488	29-747	86-3	63	E.	29-394	29-649	92-3	56	E. S. E.	...
Durbhanga	166-32	29-631	29-830	79-9	80	E.	29-494	29-663	86-0	76	E. S. E.	...
Lahore	702-22	28-727	29-422	88-7	33	S. E.	28-714	29-411	84-7	44	S. E.	...
Sirsa	661-61	28-869	29-526	89-8	60	S. E.	28-807	29-451	98-8	31	S. W.	...
Sambhar	1253-52	28-378	29-609	88-3	39	W. S. W.	28-314	29-523	96-8	16	W.	...
Jeyapore	1430-60	28-225	29-615	91-6	38	W. S. W.	28-159	29-526	99-6	13	W.	0-48
Meerut	737-48	29-005	29-753	76-4	62	N. E.	28-865	29-607	77-9	65	N. E.	0-82
Delhi	717-81	28-951	29-672	84-7	54	S. E.	28-874	29-610	72-2	81	E.	...
Agra	555-44	29-105	29-650	92-5	33	S. E.	29-005	29-538	103-1	15	S. W.	...
Lucknow	369-39	29-352	29-721	87-1	55	N. W.	29-242	29-601	100-4	31	N. W.	...
Allahabad	309-28	29-419	29-727	90-3	51	E.	29-286	29-583	105-3	20	N.	...
Benares	266-97	29-465	29-734	88-1	54	E.	29-342	29-601	102-6	26	N. N. W.	...
Ghazipur	219-74	29-531	29-751	90-7	58	E.	29-406	29-621	101-1	38	N. E.	...
Patna	182-84	29-576	29-763	84-6	69	E. N. E.	29-475	29-658	93-5	67	N. E.	...
Gya	374-9	29-347	29-724	89-7	56	E. N. E.	29-236	29-604	100-3	39	E.	...
Satna	1040-20	28-655	29-666	98-2	18	W.	28-560	29-556	104-0	11	N. W.	...
Nowgong	757-04	28-935	29-696	94-3	23	W.	28-852	29-576	103-9	11	W. S. W.	...
Jhansi	840-13	28-831	29-653	97-8	22	S. S. W.	28-737	29-547	104-2	15	S. W.	...
Neemuch	1639-36	28-069	29-678	86-1	42	W.	27-941 ?	29-500 ?	101-1	19	W.	...
Ajmere	1611	28-050	29-627	85-8	50	W.	27-996	29-538	96-9	30	S. W.	...

2nd May 1888.

Stations.	Elevation.	10 A. M.				Wind Direction.	4 P. M.				Rainfall.	
		Pressure observed.	Pressure at sea level.	Temperature.	Humidity.		Pressure observed.	Pressure at sea level.	Temperature.	Humidity.		
... Simla	7048.24	23.206	29.703	61.0	51	S. E.	23.150	29.618	61.2	57	S. E.	... 0.51
... Chakrata	7051.58	23.253	29.773	60.6	74	E.	23.201	29.721	59.7	74	N. E.	... ..
... Mussoree	6881	23.403	29.767	62.7	75	S. S. E.	23.344	29.679	63.3	72	S. S. E.	... 0.11
... Ranikhet	6068.75	24.096	29.773	64.4	68	N. W.	24.040	29.646	69.3	66	C.	... 0.28
... Pithoragarh	5368.20	24.774	29.930	59.5	88	C.	24.711	29.760	68.9	63	C.	... 0.12
... Katmandu	4387.8	25.614	29.789	73.9	54	N. W.	25.569	29.663	82.8	49	W.	... ..
... Ludhiana	811.86	28.879	29.690	87.7	34	S.	28.744	29.535	95.9	18	S.	... 0.21
... Dehra	2233.00	27.562	29.739	81.5	45	N.	27.493	29.646	86.3	36	S. E.	... ..
... Roorkes	886.63	28.851	29.729	87.3	36	S. E.	28.769	29.636	91.8	38	S.	... ..
... Bareilly	568.47	29.194	29.729	88.6	42	S. E.	29.083	29.637	96.5	39	S. E.	... ..
... Gorakhpur	255.93	29.512	29.770	88.3	57	E.	29.381	29.633	97.4	44	C.	... ..
... Durbhanga	166.32	29.616	29.787	82.5	81	E. S. E.	29.472	29.640	89.4	66	E. N. E.	... ..
... Lahore	702.22	28.959	29.665	84.2	39	S. E.	28.827	29.517	94.2	2	S.	... ..
... Sirsa	661.61	29.032	29.690	92.2	33	S. W.	28.945	29.596	96.5	40	S. S. W.	... ..
... Sambhar	1253.52	28.510	29.740	90.8	9	W.	28.426	29.629	96.4	4	S. S. W.	... ..
... Jeyapore	1430.60	28.357	29.732	92.7	11	W.	28.258	29.633	98.3	8	W. S. W.	... ..
... Meerut	737.48	29.012	29.746	85.5	49	S. E.	28.916	29.635	94.2	32	C.	... ..
... Delhi	717.81	29.016	29.740	84.2	58	S. E.	28.939	29.650	92.2	45	N.	... ..
... Agra	555.44	29.190	29.736	95.1	24	S. E.	29.104	29.641	101.9	10	S. E.	... ..
... Lucknow	369.39	29.390	29.756	93.5	48	N.	29.291	29.651	100.4	36	N.	... ..
... Allahabad	309.28	29.442	29.746	97.2	40	S.	29.311	29.608	106.8	15	W. N. W.	... ..
... Benares	266.97	29.472	29.737	94.5	53	C.	29.348	29.605	107.4	13	W.	... ..
... Ghazipur	219.74	29.533	29.752	91.8	61	E.	29.443	29.657	103.6	29	N. W.	... ..
... Patna	182.84	29.575	29.760	90.0	65	E. N. E.	29.461	29.644	94.1	49	N. N. E.	... ..
... Gya	374.9	29.357	29.730	95.0	50	C.	29.210	29.573	107.7	34	W. N. W.	... ..
... Sutna	1040.20	28.723	29.736	98.2	18	W.	28.596	29.587	102.8	12	W.	... ..
... Nowgong	757.04	29.017	29.754	96.8	25	W.	28.904	29.631	102.9	16	W.	... ..
... Jhansi	840.13	28.914	29.738	97.8	21	N. N. W.	28.817	29.633	101.9	13	W.	... ..
... Neemuch	1639.86	28.181	29.791	88.1	37	W. S. W.	28.074	29.650	97.6	25	W. S. W.	... ..
... Ajmere	1611	28.183	29.756	89.3	21	S. W.	28.074	29.621	96.4	17	S. W.	... ..

For 4 P.M., the hour nearest to those at which the storms occurred, the sea-level pressures and wind directions have been laid down on a chart for each day, and the isobaric lines have been drawn for differences of .05 inch. On the charts for the 30th April and 1st May the tornado tracks are also shown.

On the 29th, there was apparently at 4 P.M. an anticyclonic area over the Nepal Himalaya and North Behar, with an extension running north-westwards over Northern Oudh and the outer hills. The lowest pressure was in the vicinity of Sirsa on the border of the western desert, and a long V-shaped depression extended from it towards Agra and Bundelkhand. An independent region of (hypothetical) low pressure occupied the interior of Kumaun and Garhwal.

On the 30th, the pressure had fallen considerably in most places, but risen at Chakrata and Simla, and the gradients between Simla and Ludhiana were very steep. The lowest pressure was at Lahore, but a succession of V-shaped isobars projected south-eastwards to Sutna. The winds were light and somewhat irregular, though on the whole consistent with the distribution of pressure. The three storms whose tracks are marked appear to have originated in or near the line of lowest sea-level pressure and to have proceeded eastwards nearly at right angles to the isobars, that is to say, up the slope of pressure, a statement which appears somewhat paradoxical, seeing that the strongest winds were from the west, or in the same direction as the paths along which the storms progressed.

On the 1st May, there had been a considerable rise of pressure over the whole region, especially over the hills of Kumaun and Garhwal. In Dehra Dun the gradients producing S. E. or S. winds at low levels were excessively steep, but over the rest of the region they were much the same as on the previous day. The line of lowest pressure indicated by the vertices of the V-shaped isobars was however shifted a good deal to the south, and now extended from the vicinity of Sirsa through Alwar to Sutna. Over the Gangetic plain, the winds were light and irregular, but, west and south of the Jumna, they blew steadily in the directions indicated by the distribution of pressure. Both the storm tracks shown lay well to the north of the line of lowest pressure, and, as on the 30th April, the storms progressed in opposition to the baric gradient.

On the 2nd May, there were still steep gradients over the Eastern Punjab and adjacent hills, but over Rajputana, the N.-W. Provinces, Oudh, and Behar the pressure was nearly uniform, and the two isobars shown on these regions of the chart took peculiar and unusual courses. The anticyclone over North Behar and Nepal had disappeared, and the easter-

ly winds over the submontane belt were dying out. Next morning, as above stated, westerly winds reasserted themselves right up to the mountains of Nepal.

It is clear from the study of these four charts that there was nothing in the general distribution of pressure at sea-level, even just before or during the progress of the tornadoes, to account for their formation. The general features of this distribution on the first three charts are identical, yet violent storms occurred in several places on the 30th April and 1st May, whilst there was nothing of the kind on the 29th April, if we except a small hailstorm which came on late in the evening over the Siwalik hills and Roorkee.

In his *Tornado Studies for 1884* (*Professional Papers of the Signal Service No. XVI*), Finlay has found that tornado tracks in the United States lie almost invariably to the S. E. of a region of low pressure, that is to say, they lie on the side of the depression covered by warm moist winds from the Gulf of Mexico. The analogous position for the upper Gangetic plain would be the N. E. side of the depression over which moist winds from the Bay of Bengal blow, and this is where the storms under discussion actually occurred. But while the American tornadoes in all cases travel almost parallel to the isobars and in very nearly the same direction as the S. W. winds proper to the octant in which they are found, four at least of the five storms here described, and very probably the fifth also, travelled against the baric gradient and against the wind previously existing at the level of the plain. It is extremely likely therefore that the conditions of pressure which produced these tornadoes were not those existing at sea-level (for these, in a region including high mountains, are to a great extent hypothetical merely), but rather those obtaining at some definite higher plane in the atmosphere, probably, as pointed out by Mr. Archibald in a review of a French work on the experimental production of such disturbances on a small scale (*Nature*, Vol. XXXVIII, p. 104), at the place where cloud formation begins. If once a tornado is commenced at this level, it may be maintained for an indefinite time by the energy converted from the potential to the kinetic form in the condensation of vapour; and the movement may be rapidly propagated downwards by means of the viscosity of the air, and by indraught from below towards the partial vacuum in the vortex.

Now, though the situation of the Rohilkhand plain and Upper Doab at the foot of the Himalayas does not favour a proper understanding of the distribution of pressure at sea-level, it has the advantage of enabling us, by observations made at adjacent plain and hill stations, to get a very fair idea of the vertical distribution of temperature up to a height

of 7,000 or 8,000 feet; and, knowing the vertical distribution of temperature, we can compute approximately the pressure at any given height. The three stations of Roorkee, Dehra, and Mussooree lie within a horizontal distance of little more than 20 miles, but their elevations above sea-level are respectively 887, 2,233 and 6,881 feet. From observations made at these places we may therefore determine the distribution of temperature almost exactly up to about 7,000 feet, and with some approach to accuracy for one or two thousand feet further. The computed temperatures up to 10,000 feet for 10 A.M., and 4 P.M. each day, derived from the observations of these three stations, are the following:—

Height.	29th April.		30th April.		1st May.		2nd May.	
	10 A. M.	4 P. M.	10 A. M.	4 P. M.	10 A. M.	4 P. M.	10 A. M.	4 P. M.
Sea-level ...	100·2°	106° 0'	94° 4'	94° 9'	72·3°	82·9°	90·5°	95·0°
1,000 Feet ...	94·2	98·4	89·0	92·7	70° 0'	82·3	86·5	91·4
2,000 " ...	88·8	91·5	84·2	89·8	67·3	80·5	82·5	87·3
3,000 " ...	84·0	85·4	80·0	86·2	64·2	77·5	78·5	83·0
4,000 " ...	79·8	80·1	76·4	81·9	60·6	73·3	74·5	78·3
5,000 " ...	76·2	75·4	73·4	76·8	56·7	67·9	70·5	73·4
6,000 " ...	73·2	71·5	71·0	71·0	52·3	61·3	66·5	68·1
7,000 " ...	70·8	68·3	69·2	64·4	47·5	53·5	62·5	62·5
8,000 " ...	69·0	65·8	68·0	57·1	42·3	44·5	58·5	56·6
9,000 " ...	67·8	64·1	67·4	49·1	36·6	34·3	54·5	50·3
10,000 " ...	67·2	63° 0'	67·4	40·3	30·6	22·9	50·5	43·8

The temperatures given in the last three lines are of course subject to doubt, but up to 7,000 feet they may be accepted as correct. They have been computed by the formula $t = t_0 + ah + bh^2$, the three constants being determined by the observations of Roorkee, Dehra, and Mussooree.

On the 29th April, both at 10 A. M. and 4 P. M., the vertical distribution of temperature was similar to the normal distribution in May, given on page 152, that is to say, the decrease on ascending was at first very rapid, but became less and less rapid as the height increased. When the decrease is more rapid than 1° in 183 feet, or $5\cdot46^\circ$ in 1,000 feet, the equilibrium of the atmosphere is unstable and convective movements are almost certain to occur. Under ordinary circumstances, as on the 29th April, these disturbances commence at the level of the plain and probably bring about an interchange between the lowest layers of the atmosphere and others at a considerable height,* such move-

* To this interchange the hot west winds are probably due, the feeble and irregular currents of the lower atmosphere being replaced during the hottest hours of the day by steady west winds descending from an upper layer.

ments being often accompanied by whirlwinds of any size from the little dancing "devil" or *bhút* to a big dust-storm. As long, however, as they do not extend up to the cloud layer, they produce no precipitation, draw upon no important source of energy, and give rise to no violent tornadoes.

At 10 A. M. on the 30th, the conditions were similar to those just described, though the temperature over the plain was considerably lower than on the previous day; but by 4 P. M. a rapid decrease of temperature at high levels had commenced, and above 5,000 feet the conditions were such as to produce convection currents extending upwards to an unknown height. During the night the greater nocturnal fall from the mean temperature at the lower stations restored the conditions of stable equilibrium, but by 10 A. M. on the 1st May unstable conditions again appeared at heights of 7,500 feet and upwards, and by 4 P. M. these conditions extended down to below 5,000 feet. On the 2nd May, the temperature at 10 A. M. decreased uniformly upwards at the rate of 4.0° for 1,000 feet—a rate consistent with stable equilibrium; but in the afternoon conditions likely to produce convective disturbances reappeared at heights above 6,000 feet. On the 3rd, the normal conditions were completely re-established.

It would therefore seem that the occurrence of the tornadoes of the 30th April and 1st May was intimately connected with a sudden fall in the temperature of the air from 5,000 or 6,000 feet upwards—a fall so rapid that powerful vertical convection currents were certain to supervene. What the cause of this fall of temperature may have been is not known, but presumably it was connected with the influx of easterly or south-easterly winds of a moderate temperature, at a time when the temperature at the level of the plains was excessively high. On the 30th, the disturbances, which were probably due to this relatively low temperature at high levels, commenced rather late in the afternoon—after 4 P. M.; but on the 1st May, when unstable conditions appeared as early as 10 A. M., the tornadoes took place at an earlier hour, probably commencing about 2 P. M.

When no source of energy is drawn upon in an atmospheric disturbance, except the sensible heat of the air and its actual energy of motion, the disturbance is not likely to be very violent or of long duration; but when the indefinitely large supply of energy which is stored in the form of the latent heat of vapour begins to be converted into the kinetic form, the disturbance may be greatly intensified and prolonged to an indefinite extent. Hence the dust-storms of the hot weather never acquire any great violence, unless they extend upwards to such a height that condensation of vapour occurs, and in very dry

weather this does not take place until a height but seldom attained is reached. In the cases now under discussion it is probable that, owing to the moist air brought in by easterly winds and the upward diffusion of the vapour during the three or four very hot days preceding the 30th April, the plane at which condensation commenced when the rapid fall of temperature set in that afternoon was unusually low for the time of year. If we adopt Hann's formula for the vertical distribution of aqueous vapour, and compute its constants from the observations of Bareilly, Roorkee, Dehra, Mussooree, Chakrata, Ranikhet, and Pithoragarh (a large number of observations of this somewhat erratic element being desirable), we get the following results for 4 P. M. each day:—

29th April, $\log f = 9.7352 - .0316 h$.

30th „ $\log f = 9.7412 - .0275 h$.

1st May, $\log f = 9.7630 - .0370 h$.

In these formulæ f is supposed to be expressed in decimals of an inch of mercury and h in thousands of feet. In Hann's general formula for all seasons and places the co-efficient of h is .0462. On the 30th of April therefore the rate of diminution of vapour pressure with increase of height was only $\frac{2}{3}$ or $\frac{2}{3}$ of the average rate, whilst the decrease of temperature from 5,000 feet upwards was very rapid. On the 1st May, the vapour diminished rather more quickly, but the decrease of temperature was so rapid as to overtake it and cause condensation at the same or a lower level. If we compare the pressure of saturated vapour at the temperature of the air with the actual vapour tension given by the above formulæ, we find that, on the 29th, the relative humidity was below 50 per cent., even at 10,000 feet, whilst on the 30th condensation commenced at about 9,300 feet and on the 1st May at 8,000 feet:—

Tension of vapour at 4 P. M.

Height.	29th April.		30th April.		1st May.	
	Saturated.	Actual.	Saturated.	Actual.	Saturated.	Actual.
Sea level	2.307"	.514"	1.645"	.551"	1.127"	.585"
1,000 feet	1.809	.502	1.537	.518	1.105	.538
2,000 "	1.481	.463	1.404	.488	1.043	.494
3,000 "	1.221	.428	1.253	.459	.945	.453
4,000 "	1.029	.395	1.091	.432	.821	.416
5,000 "	.881	.365	.923	.406	.684	.382
6,000 "	.773	.337	.760	.382	.544	.351
7,000 "	.693	.311	.606	.360	.411	.322
8,000 "	.636	.287	.468	.338	.295	(.296)
9,000 "	.600	.265	.350	.318	.199	(.272)
10,000 "	.577	.245	.251	(.300)	.122	(.250)

The figures in brackets are computed by the above logarithmic formulæ for the actual distribution of vapour up to the highest observing stations, but as they exceed the pressures of saturation at the probable temperatures of the air they do not represent actual facts. The differences between them and corresponding pressures of saturated vapour represent in fact the vapour which must have been condensed. It thus appears that on the afternoon of the 30th April, and probably throughout the greater part of the following day, the distribution of temperature was such as to cause vertical movements of the atmosphere above the level of 5,000 or 6,000 feet, and that the cloud level, even supposing no such movements to be in progress,* was probably at the comparatively low elevation of 8,000 or 10,000 feet. The conditions were therefore favourable for the development and intensification of any disturbances casually occurring in the currents set up. It now remains to inquire whether any relation can be traced between the places of occurrence and tracks followed by the tornadoes and the distributions of pressure at or near the cloud level where they in all probability commenced.

For this purpose, the 4 P. M. observations of pressure on each of the two days of the storms have been reduced to a level of 9,000 feet above the sea, and the resulting values are laid down on the last two charts. These high-level pressures have been computed on the assumption that the temperature decreased each day on ascending according to the scale above shown—an assumption which is probably not far wrong as regards the Himalaya stations, and the line of nearest stations on the plains, *viz.*, Ludhiana, Roorkee, Bareilly, and Gorakhpur, but perhaps rather wide of the truth as regards more distant places. If the decrease of temperature above the more distant stations was less rapid, as is probable, the effect of the assumption made must be to diminish the pressures towards the south of the area covered by charts, making the gradients for westerly winds less steep, though in other respects producing little change. Thus the pressures as computed for Bareilly and Agra are almost identical on the 30th April, and differ by only 0.217" on the 1st May; whilst, if we assume for Agra the rate of decrease of temperature found by Glaisher in his balloon ascents in clear weather, the excess of Agra over Bareilly at the 9,000 feet level is 0.247" on the 30th and 0.333" on the 1st. The computed pressures at 9,000 feet are given in the following table and have been laid down on charts V and VI:—

* In an ascending current, since there is no diminution of the quantity of vapour until condensation commences, cloud will be found wherever the expansion due to upward motion has reduced the temperature to the dew point.

Pressures at 9,000 feet 4 P. M.

Station.	30th April.	1st May.	Station.	30th April.	1st May.
Simla ...	21.494"	21.505"	Jeypore ...	21.613"	21.602"
Chakrata ...	21.492	21.499	Meerut ...	21.473	21.346
Mussooree ...	21.516	21.541	Dellhi ...	21.524	21.378
Ranikhot ...	21.505	21.542	Agra ...	21.540	21.614
Pithoragarh ...	21.550	21.551	Lucknow ...	21.601	21.614
Katmandu ...	21.579	21.643	Allahabad ...	21.610	21.662
Ludhiana ...	21.425	21.362	Benares ...	21.585	21.641
Dehra ...	21.509	21.523	Ghazipur ..	21.536	21.634
Roorkee ...	21.463	21.411	Patna ..	21.415	21.563
Bareilly ..	21.511	21.397	Gyn ...	21.521	21.614
Gorakhpur ...	21.425	21.491	Sutna .	21.625	21.655
Durbhanga ...	21.317	21.467	Nowgong ...	21.639	21.664
Lahore ...	21.287	21.288	Jhansi ...	21.633	21.640
Sirsa ...	21.503	21.494	Neemuch ...	21.654	21.651
Sambhar ...	21.570*	21.560	Ajmere ...	21.590	21.587

The charts indicate very clearly that on both afternoons there was at the cloud-level a low pressure region overlying the Punjab and another over Behar, and that these two regions were connected by a long narrow trough of low pressure extending over Rohilkhand and the north of Oudh. The conditions were therefore both days such as were likely to generate eddies by the interference of the easterly and westerly currents along the low-pressure axis; but at 4 P. M. the isobars were more regular and the conditions likely to generate tornadoes better marked on the 1st May than on the 30th, April. On the 30th, at this hour in the afternoon, the low-pressure trough over Rohilkhand was almost completely blocked by a region of relatively high pressure near Bareilly, caused apparently by the upheaval of the pressure planes there, on account of the local high temperature (99.8°). Towards sunset this obstruction doubtless disappeared with the fall of temperature below, and then the distribution of pressure became similar to that of the 1st May. At any rate, whatever may have been the reason, the tornadoes of the 30th did not commence until near sunset, whilst on the following day they began in the middle of the afternoon.

The tornado tracks shown on the two high-level charts have a very definite relation to the isobars. *They commenced a little to the south of the low pressure axis, and approached slightly or ran parallel to it for a certain distance, but in no case succeeded in crossing it.* These storms, as regards the horizontal components of their motions, appear therefore to have been eddies formed in the strong westerly currents of the lowest

cloud layer where these began to be retarded on approaching the low-pressure axis, and they were carried forward with the current in which they originated. Regarding the vertical movements and the production of hail, of the origin of which Ferrel's theory appears to me to be the true one, it is impossible for want of information to enter into any detail. The form of the storm-cloud, so indicative of vertical suction as well as of horizontal whirling movements, and to which so much attention has been paid in America, is not even mentioned in any of the local reports.

APPENDIX I.

CIRCULAR LETTER OF INQUIRY AND REPLIES FROM DISTRICT OFFICERS.

Circular.

Having been charged by the Meteorological Reporter to the Government of India with the preparation of an account of the origin and history of the destructive storm which recently visited Moradabad, I have the honour to request the favour of your assistance in furnishing materials for discussion regarding the storm in so far as it affected your district.

From the reports received from your *tahsils* and *thanas* I have to request in particular that you will be good enough to furnish me with an abstract of the information on the following points:—

1. The date and hour at which the storm commenced in those places where it was felt, and its duration at each place
2. The direction of the wind at each place at the beginning, middle and end of the storm.
3. An estimate of the force of the wind from observation of the damage done by uprooting trees, unroofing houses, &c.
4. Whether the storm was accompanied by hail or not, and if hail was observed, what was the average size of the hailstones?
5. How many people were killed, if any, and how they were killed, whether by lightning, falling in of houses, or from what cause?
6. What was the estimated value of the total damage done by the storm?

As the path of the storm seems to have avoided the regular meteorological observations, I shall be glad if you happen to be able to furnish any *barometric* or *thermometric* observations made during its passage.

REPLIES.

(1) Letter No. $\frac{1272}{XII-353}$ dated 30th May, 1888, from the Collector of Moradabad to the Meteorological Reporter to Govt. N.-W. P. and Oudh.

With reference to your 417 dated 16th May, 1888, I have the honour to enclose a copy of my report $\frac{1147}{XII-353}$ dated 7th May, 1888, which gives nearly all the information which I have been able to collect regarding the late storm.

2. Although, as I shall mention hereafter, there were slight storms at other places, the really severe storm was confined to Moradabad and a small area round it. It took place on 30th April. The dust-storm began about 6 p. m., the hurricane and hail about a quarter past 6. The hurricane and hail lasted between a quarter of an hour and twenty minutes. It is of course not easy to determine the exact point of time when the storm stopped. There was a good deal of wind, and very strong wind for some time afterwards.

3. As far as I myself noticed the wind was north-west throughout. Some of the tahsildars say that the wind was first west and then changed to north. One tahsildar says that the wind was east, but I have no doubt that this is a mistake.

4. The wind was certainly travelling at about 60 miles an hour, at least so I am informed by people who know more of such things than I do.

5. There was a terrific hailstorm; the bigger hailstones were of the size of small pigeon's eggs.

6. For an answer to your question 5, see para. 5 of my report.

7. It is very difficult to estimate the amount of the damage done. Fortunately there was little damage done to crops, but there was a great deal of damage to houses. The total damage done cannot have exceeded, in my opinion, a lakh of rupees. It was the loss of life which made the storm so noteworthy.

8. Regarding the tahsils, there was no storm of any kind at Bilari. There were slight storms with a little hail and rain at Thakurdwara and Amroha on the evening of the 30th and slight storms at Sambhal and Hasanpur on the 1st of May. But all these storms were so slight that they probably would not have been noticed had it not been for their connection with the great storm at Moradabad.

Moradabad does not boast a barometer, and thermometric observations do not appear to have been taken by any one during the storm. Most people's roofs were either blown off or tumbled in, a state of things

which I am sure you will understand does not conduce to the taking of correct meteorological observations. It was bitterly cold during the storm and for a considerable time after it.

(1 a.) Letter No. $\frac{1147}{XII-353}$ dated 7th May, 1888, from the Collector of Moradabad to the Commissioner, Rohilkhand Division, Barielly.

In accordance with the instructions contained in your $\frac{235}{XII-84}$ dated 5th May, 1888, I have the honour to submit a brief report regarding the storm which occurred on the 30th April 1888, of the main features of which His Honor the Lieutenant-Governor and yourself have been already apprised.

2. I myself only arrived in Moradabad on the 30th, so that at the time of the calamity I was under the disadvantages of having no local knowledge of the place. I took charge in the afternoon and about 6 in the evening I drove to the house usually occupied by the Collector, standing on the rising ground on the further side of the race course. I briefly mention what happened to myself because the house where I chanced to be and the adjoining one, standing as they do on the ridge of the rising ground on which the station of Moradabad is situated, were the houses on which the fury of the storm first fell and which seem to have suffered more than any others. Soon after I entered the storm commenced. It became quite dark and the house was filled with dust. The doors were burst open by the wind. A terrific storm of hail followed breaking all the windows and glass doors. The verandahs were shorn away by the wind. A great part of the roof fell in and the massive pucca portico was blown down. The walls shook. It was nearly dark outside and hailstones of an enormous size were dashed down with a force which I have never seen anything to equal.

3. As soon as the storm abated I went out. The race course was mostly covered with water. There were also long ridges of hail on the higher ground one or two feet or more in depth. The roads were strewn with trees; there were very few to be seen standing; many of the largest ones had been torn up by the roots. The roof of the first house I saw had been blown altogether away, leaving only the broken walls standing. The double-storeyed barracks had stood though seriously injured, but one of the single-storeyed ones had collapsed. There is not a single house in the civil station which did not sustain the most serious injury. Had the hurricane lasted a few minutes longer scarcely a house could have been left standing. But little harm comparatively

was done in the city. It stands lower than the civil station, and the streets being narrow and the houses closely packed together the wind had less power, and there was more protection from the hail. Damage of course there was. Tiles were blown off, windows broken and balconies and badly built *kutchas* walls shaken or sometimes blown down, but there was nothing like the damage which there was in the civil Station.

4. The really destructive hail seems to have been confined to a very small area, about six or seven miles round Moradabad. There were slight storms at Thakurdwara, Bilari, and Sambhar, but nothing of any consequence. The rest of the district appears to have escaped altogether.

5. There have been up to date 222 inquests on bodies of persons killed in the storm. There are a few more reports in cases in which it was not possible to hold inquests. 230 deaths in all have been reported up to the present time. There are no doubt some deaths which have not been reported, but not many. The total mortality may safely be put as under 250. The vast majority of the deaths were caused by the hail. Some were caused by the falling of trees or walls, but these were comparatively few. Men caught in the open and without shelter were simply pounded to death by the hail, 14 bodies were found on the race course, 4 almost immediately in front of the house known as the Collector's. There were no deaths from hail in the city itself and not many in the environments. Most of the deaths were in the bare and level plains round the station where people were caught unawares. More than one marriage party was caught by the storm near the banks of the river and was annihilated. No Europeans were killed.

6. The police report that 1,600 head of cattle, sheep, and goats were killed, but probably a good many strays were, as was very natural, put down at first as killed. Beyond the cattle and the damage done to houses, there was not much loss. There were fortunately no crops on the ground to be destroyed. Most of the grain had been threshed and stored. The grain was blown away from some threshing-floors, but the loss in this way was not considerable. I should not omit to mention that many valuable groves and mango trees have been destroyed.

7. The most serious damage was done in the Cantonment. I at once offered the officer commanding all the assistance in my power. The Municipal staff which could be spared was deputed to assist in clearing the roads &c., and I procured as many workmen as possible. Owing mainly to Captain Mackenzie's energy all that was possible has been done to remove the signs of the disaster, but it will I fear be many years before Moradabad is itself again.

8. To sum up so far as the people are concerned, the loss of property was comparatively small owing to the fortunate circumstance of there being no crops on the ground. Had there been such, they must have been utterly destroyed. The damage to the houses will of course be repaired by the people themselves. The loss in grain from the threshing-floors was trifling. It may be necessary to ask for an increased *takavi* grant for the purchase of cattle; but the people of this district are averse to taking these advances, and I cannot say at present whether any increase of budget provision will be requisite. Almost all the public buildings require special repairs, most of which have been already taken in hand.—Should any special assistance be required from Government it will be applied for hereafter.

(2.) *Report on the occurrence of a violent storm accompanied by hail on the 1st May, 1888, at Shahjahanpur.*

The storm occurred with violence only in two tahsils, Tilhar and Shahjahanpur.

(a.) In the west of the Tilhar tahsil (Jaintipur) the storm began at 2 on 1st May 1888 and lasted (along with the hailstorm) till 3-30 or so.

In Tilhar itself it began at 3 P. M. and lasted till 4 P. M.

(b.) In Shahjahanpur the storm began at 4 P. M. and lasted till about 5 P. M.

2. (a) In the west of Tilhar tahsil the wind first came from the west, then it stopped for about 5 minutes and a north wind accompanied by hail set in.

(b.) In Tilhar itself the wind blew from the west, then it turned to the north with hailstones.

(c.) In Shahjahanpur the wind began from the west, then it turned round quite suddenly without warning to the north and hail fell.

3. Trees were blown in several cases 10 to 15 yards. Thatched roofs were blown 25 or 30 yards where the wind got a proper hold of them.

4. The storm began with a west wind which was very violent. The north wind brought hail and was not so violent by any means.

(a.) I have asked a great many inhabitants of the west of Tilhar tahsil about the size of the hailstones. They all agree that the stones average nearly 3 inches in diameter and that many were longer.

(b.) In Tilhar the stones are estimated as bigger than goose eggs.

(c.) In Shahjahanpur the stones were longer, but nothing so very extraordinary.

5. I cannot tell how many exactly were killed, but not more than 10 or 12. Every one had had full warning before, as a heavy dust-storm had been going on nearly an hour before the hurricane commenced. At least 2 men were killed by hail, 2 by the falling of a house, 1 by the falling of a cart loaded with *bhusa*, and the rest by trees. The hail wounded a very large number.

6. It is impossible to estimate the total damage done in the district by the storm.

Quite 2,000 trees must have been uprooted and very many others sadly knocked about. The melon crops were injured. The damage done to Government buildings in the two tahsils roughly estimated at Rs. 360.

Unfortunately I have not been able to hear of any barometric &c. observations made during the storm.

When the north wind began to blow there was a considerable fall of temperature.

(3.) *Abstract of Tahsildars' reports and replies to the questions set by the Meteorological Reporter to Government.*

ANSWERS BY TAHSILDARS OF					
QUESTIONS.	BUDAUN.	DATOGANJ.	SAHASWAN.	BISOLI.	GUNNAUR.
1. Date and hour at which the storm commenced in those places where it was felt and its duration at each place.	The storm was felt in the northern part of the Tahsil between 4 and 5 P. M. on 30th April 1888. Duration about 1 hour. It was felt more in Pergana Budaun and less in Ujhani.	Of the 5 Thanas in this Tahsil, 2 Dotaganj and Sudullaganj were visited by the storm. Also Hazratpur to a less extent. Was felt at 4 P. M. on 1st May 1888 duration 10 minutes everywhere.	There was no storm so to all in this Tahsil, but on the 30th April 1888 there was an ordinary wind storm accompanied by drops of rain and very small sized hailstones, causing no loss or damage. It had come from west.	No storm felt here or in this Tahsil.	Very strong and high wind at 6 P. M. on 30th April. Duration 2 to 2½ hours Gunnaur.
2. Direction of wind at the beginning, middle, and end of the storm.	South-westerly in the beginning. North-east in the middle. Easterly in the end of the storm.	North-westerly in the beginning passing on south eastwards. No change in the middle.	an ordinary wind storm accompanied by drops of rain and very small sized hailstones, causing no loss or damage.		Westerly in the beginning and then throughout the duration north-westerly passing to south-east.
3. An estimate of the force of the wind from observation of the damage done by uprooting trees, unroofing houses &c.	Uprooting of trees occurred. Force of the wind estimated to be equal to 3 elephants' force combined.	Estimated force equal to 16 horses combined.			No damage of the kind. Hence no estimate of its force can be accurately framed.
4. Whether storm was attended with hail and of so what was average size of the hailstones.	There was a slight shower of hailstones. Average size 2 to 2½ tolas.	Hailstones attended the storm—average diameter ½ inch.			No rain, no hailstones. Only cloud.
5. How many people were killed, if any, and how they were killed, whether by lightning, falling in of houses, or from what cause.	No death due to storm in this Tahsil.	2 men killed by falling down of trees in Dotaganj.			No casualties.
6. What was the estimated value of the total damage done by the storm.	Faslsaid, mango and Jaman fruit suffered damage estimated, 6 annas in the rupee. Trees uprooted numbered 5 per cent.	Estimated loss of sheep, goat, buffalo, oxen and fruit and groves amounted to Rs. 1000.			No damage.

- (4.) Letter No. $\frac{2428}{XII}$ dated 27th June, 1888, from the Collector of Bareilly to the Meteorological Reporter to Govt. N.-W. P. and Oudh.

I have the honour to reply as to—

Point I. At (a) Behari, commenced 6 P. M., continued to 8 P. M.

(b) Nawabganj, commenced 7 P. M., continued to 9 P. M.

Point II. (a) at commencement N.-W. then W. finally E.

(b) at commencement W. then cyclonic, finally W.

Point III. Force about 28lbs. to square foot.

Point IV. Hailstones averaging about $\frac{1}{2}$ chattack.

Point V. (a) 16 men by hail, 1 by lightning and 7 by falling boughs and other causes.

Point VI. About 4,000 to 5,000.

Baheri is the purgannah stretching right across the north of the District of Bareilly. Nawabganj lies to the south-east of it.

(5.) *Statement showing particulars of the Storm of 30th April, 1888.*

DISTRICT.		PILIBHIT					
Tahsil.							
REMARKS.		The date and hour at which the storm commenced in those places where it was felt and its duration at each place.		Pilibhit...		
		The duration of the wind at each place at the beginning, middle and end of the storm.		Bisalpur		
		An estimate of the force of wind from observation of the damage done by up-rooting trees, unroofing houses, &c.		Purampur		
Whether the storm was accompanied by hail or not, and if hail was observed, what was the average size of the hailstones.			Storm was accompanied by hail, some were three quarters of a seer in weight.			
How many people were killed, if any, and how they were killed—whether by lightning, falling in of houses or from what cause ?			Storm was accompanied by hail, the size of hailstones was equal to a plum of ordinary size.			
What was the estimated value of the total damage done by the storm ?			Storm was accompanied by hail, the size of hailstones was equal to a plum of ordinary size.			
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			Storm was accompanied			

- (6.) Letter No. $\frac{1281}{XII-599}$ dated 22nd May, 1888, from the Collector of Bijnor to the Meteorological Reporter to Govt. N.-W. P. and Oudh.

In reply to your letter No. 425 dated the 17th instant, I have the honour to state that the storm of 30th April was very slightly felt in this district, and was not accompanied by much wind. In a few places small hailstones fell, but no damage was caused. No persons were killed so far as I have been able to discover. If necessary I shall submit a further report, but as the storm was so slight, I do not think I shall be able to furnish the information required.

- (7.) Letter No. $\frac{860}{XII-6}$ dated 21st May, 1888, from the Superintendent, Tarai District, to the Meteorological Reporter to Govt. N.-W. P. and Oudh.

In reply to your No. 429 dated the 17th instant, I have the honour to furnish information on the points noted, with reference to the destructive storm which recently visited Moradabad.

1. A slight storm but nothing of any moment passed over the Tarai on the 30th April, and lasted from about 5.30 to 6 p. m.

2. The wind was from the west.

3. No estimate was made of the force of the wind, and no particular damage was done by it.

4. The storm was not accompanied by hail.

5. No people were killed either by lightning, falling of houses, or any other cause.

6. No damage was done by this storm.

7. No barometric or thermometric observations were available. The Tarai was not in the line of the storm.

- (8.) Letter No. $\frac{2014}{XII-117}$ dated 23rd June, 1888, from the Collector of Meerut to the Meteorological Reporter to Govt. N.-W. P. and Oudh.

In reply to your No. 418 of the 16th May, 1888, I have the honour to say that I have caused enquiries to be made in the different tahsils of the district. This enquiry was undertaken as there had been no definite report of any severe damage caused by a dust-storm and the making of it has caused the delay in replying.

2. The Moradabad storm occurred, I think, on April 30th last. On the evening of that day in Meerut itself there was a slight dust-

storm from the north-west which did no damage at all; it came on about 6 P. M.

3. In Hapur between 4 and 5 P. M. there was a dust-storm which lasted about ten minutes accompanied by same rain and a little hail of small size. There was no damage done. The wind was strong at first and from the north, it then turned east and boxed the compass.

4. In Mowana the storm occurred later and lasted from about 8 to 10 P. M. The wind was strong at the beginning and at the end. Several trees were uprooted and some houses unroofed, but no persons were killed. In the uplands hail was small, about the size of a gram seed, in the Ganges valley it was larger and did some damage to melons. In no other tahsil was there any disturbance that day.

APPENDIX II.

(1.) EXTRACTS FROM THE TELEGRAPHIC AND CORRESPONDENCE COLUMNS OF THE PIONEER (ALLAHABAD).

Delhi, 1st May.

A severe thunderstorm passed over the station this afternoon. Two trees have been struck by lightning and there is no doubt that other damage has been done, as several crashes have been heard. It has been raining and blowing hard since 3 o'clock, and there was a sharp and most destructive shower of hail between 3 and 4 o'clock, some of the stones being of extraordinary size. I picked up one as big as a man's fist which weighed two and a quarter ounces. This, I fancy, decides the fate of our mango crop and our fruit prospects generally.

Since preparing the above for despatch I hear that a lad aged four, who ran out during the hailstorm to pick up some of the stones, was killed on the spot.

2nd May.

As far as is known at present the hailstorm last evening would appear to have been local in its effect, all the damage up to the present being reported from the city and civil station of Delhi, and the western suburbs of Sabzimandi and Paharganj. The storm seems to have travelled in a south-easterly direction, for after passing over Delhi and crossing the Jumna, it went on in the direction of Meerut and Bulandshahr.

Several persons are reported to have been killed during the storm,

but the details need confirmation. A house outside the city was struck by lightning, but it was fortunately untenanted at the time. The lightning descended through the roof in the centre room and struck the floor; it then glanced off and, darting through a side room, passed out into the open.

3rd May.

The hailstorm on Tuesday afternoon was quite phenomenal in character. Later reports show that it was a far more remarkable occurrence than would appear from my telegrams. The stone picked up by me weighed two and a quarter chittacks, not ounces, as erroneously stated at first; and, incredible as it may seem, one picked up in the hospital garden in the fort weighed one and a half pounds. More extraordinary still, another hailstone secured near the telegraph office was of the size of an average melon, and turned the scale at two pounds.

These stones were weighed in the presence of reliable witnesses by two gentlemen of unquestionable veracity, and I have satisfied myself that there is not the least reason to doubt the authenticity of these reports. As it is possible, however, that many will still feel disinclined to credit my statement, and as the Meteorological Department will doubtless require full and reliable information in regard to what is here believed to be the most remarkable fall of hail on record, I am prepared to furnish any further particulars which may be needed, and to give the names and addresses of the gentlemen who weighed the enormous hailstones referred to.* I am also in a position to produce any further evidence which may be required to substantiate my facts.

The fall for about two minutes presented the appearance of a shower of lumps of ice, most of which smashed on coming in contact with the earth, only those which fell into soft earth having been secured intact. The shape of the stones generally was a flat oval, very few being round like ordinary hail. All kinds of rumours are flying about in regard to persons killed and injured during the storm, but, as several of these are doubtless exaggerated, if not absolutely imaginary, it would be unsafe to give particulars at present. It is a fact, however, that out of a flock of some fifty geese and ducks which were in a tank near the Ridge when the hail descended only nine were spared to the owner. It is true also that the lightning struck a thatched building in the same vicinity, and killed a man and woman who had taken shelter in it.

5th May.

- Up to the present eleven persons are reported to have been killed

* References to these gentlemen have been given to me.

during the storm on Tuesday last. One man literally had his head split open, and over 200 persons are said to have been injured more or less. The full extent of damage to fruit and vegetable crops has not yet been correctly ascertained, but it is reported to be very serious.

7th May.

I have little to add to the particulars already furnished by telegraph in reference to the recent hailstorm at this place except that two or three additional deaths have been reported, and that the damage to the fruit and vegetable crops has been quite as serious as I had surmised. On both banks of the Jumna for about two miles above the railway bridge, and for a mile below that point, the melons have almost been completely destroyed owing to the necessarily exposed situation of the fields; and in the city and surrounding gardens very few mangoes are now to be seen. It is very fortunate, indeed, that the hailstorm was confined to so limited an area, or the damage would almost have amounted to a district calamity. The country to the north and south of Delhi, within a couple of miles of the city on either side, does not appear to have felt the effects of the storm in the least, and as the distance from the Jumna Bridge to the borders of the Rohtak district is only about 25 miles, the actual area effected in this district could scarcely exceed some 50 square miles.

Moradabad, 2nd May.

A terrific storm of hail and wind occurred here on the evening of the 30th ultimo. Most of the houses in the civil station have been unroofed, but little damage comparatively speaking has been caused in the city. Above 150 deaths are reported up to date, mostly from hail. Some details have reached us of the terrific storm referred to in our telegram from Moradabad. The storm began on the evening of April 30th. The wind blew with tornado-like strength, rain fell in torrents, and at intervals there were heavy showers of hail. Nearly every tree in the station was uprooted and the roads were blocked for miles by the fallen timber. Large numbers of mud huts were beaten down, while in the cantonment much damage was also done. The majority of the houses were unroofed, the north-west wall of the racquet-court was blown bodily down, and the house of the Judge adjoining was also damaged. The portico of Mr. Fisher's house fell, smashing up the Collector's horse and trap which were standing beneath it. But the most serious consequences resulted from the showers of hail, the stones being of phenomenal size. Natives who were exposed in the open were, to quote a correspondent, "half-frozen by the cold wind and then killed outright by the hailstones." Others were struck by falling trees or

injured by the collapse of their huts. One hundred and fifty deaths had been reported up to Tuesday evening, and the full returns had not even then been received. There were signs that day of a renewal of the storm, but the danger passed over. The temperature remained almost as low as in February, the change being most marked after the recent great heat. Masses of frozen hail were to be seen lying about the station long after the storm had ceased.

Our Moradabad correspondent writes under date 2nd May :—" People here say nothing like the storm was ever known before. About 6 A. M. I was looking at the house which I had taken, the one usually occupied by the Collector here, standing on the race-course. The house suddenly became dark and full of dust. A terrific storm of wind followed. Most of the doors were burst open and the glass broken by the hail that followed almost immediately. Part of the roof fell in. The verandas were blown asunder. The heavy masonry porch fell, crushing the horse and phaeton standing underneath. When I came out the race-course was covered with water. Many of the houses in the civil station had been completely unroofed, including one of the barracks. Most of the trees had been blown down and were strewn on the road. Not much damage seems to have been done in the city. One hundred and sixty deaths have been reported up to the time I write, and no doubt some more reports will come in. Most of the deaths were from hail, a few from the falling of walls and trees. The hail appears to have stopped within a few miles of Moradabad. Most of the district escaped completely. One of the two companies of the Seaforth Highlanders stationed here is leaving for Bareilly in consequence of the unroofing of the barracks."

A correspondent writes from Camp Tilhar, Shahjehanpur district, 3rd May :—" It may be interesting to trace the course of the storm of the 1st. This place is 12 miles west of Shahjehanpur on the O. and R. line. The whole of that day a strong east wind had been blowing: about 3-30 P. M. a bank of dust came up from the west and the wind then changed. It only appeared at first one of the usual dust-storms, but after a slight fall of hail the storm became very violent, rain poured in streams, and hailstones fell, the size of which astonished all, and I am not exaggerating when I say that many were the size of a turkey's egg, while the smallest were the size of a pigeon's. I regretted afterwards I had not been able to weigh some, but I would not venture out myself and so could hardly ask anyone else. The storm lasted until 4-30. The destruction to trees has of course been great, but I have only heard of the loss of one life.

"The opium cultivators who were congregated in the groves of trees

escaped in a most miraculous way, for branches of trees were falling all round them, but only one man was slightly injured. The shed which has been built for their convenience had half the roof blown down, while houses innumerable have been unroofed. In all the years that I have been in India it was the severest storm that it had ever been my lot to witness."

A Naini Tal correspondent writes under date 2nd May :—"Another sharp thunderstorm, with heavy rain, broke over the station last evening about 6-30 P. M., and one or two minor ones occurred during the night. The great storm of yesterday did much damage, the roads being strewn with the leaves of trees, cut off by the hail, and all flowers, fruit trees, &c., exposed to its violence were cut to pieces. Government House suffered severely, and nearly two hundred panes of glass were broken by the hail. Clouds are still hanging about, and the distant roll of thunder proves that the disturbance of the elements is not yet over. The traditional 'oldest inhabitant' cannot remember such severe weather in the month of May, but it seems to be part of the same storm that has broken over Calcutta, Darjeeling, &c."

(2.) EXTRACTS FROM THE *Civil and Military Gazette* (LAHORE).

Moradabad, 1st May.

A perfect cyclone swept over Moradabad last evening. The wind was so high that it blew sixty empty goods vans from the sidings in which they were standing for at least two miles out of the station along the line in the direction of Chundousie. This was not sufficient. Dame Nature, not content with a rather heavy goods train, thought she might as well have a mixed train, and sent after them thirteen empty lower class carriages. All these seventy-three vehicles went careering gaily along the line by themselves for two miles without let or hindrance, when the foremost of them met with an unfortunate bullock lying across the line, and no cow-catcher being at hand, it was, as Stephenson predicted, bad for the "coo"; but it was still worse for the empty goods vans, for the first one, in coming in collision with the bullock, got derailed, and all the others followed suit, tearing up the track for a distance of about two miles. Some of the vans were turned upside down, and looked somewhat like huge tortoises on their backs. The train, which should have reached Bareilly at 3-14 A. M., never turned up at all. But the train from Allyghur, due at 10-2 P. M., did not arrive till 3-14. A very large peepul tree between Chundousie and Moradabad had been torn up by its roots and sent right into the telegraph posts, which not only knocked them down, but destroyed them entirely for a considerable distance on both sides. The wreck of broken and damaged carriages was amazing.

Bareilly, 1st May.

A violent storm of quite a cyclonic character burst on and in the vicinity of the Rohilkhand and Kumaon line last evening. At Bareilly it began to blow in violent gusts about half-past 7 and raged at intervals, subsequently accompanied by rain till about 12 o'clock, in fact, even up to 4 this morning there were heavy showers. The corrugated iron roofs of the Deonarain and Richha Road stations, respectively at $21\frac{1}{2}$ and $27\frac{1}{2}$ miles from Bareilly, were blown off, and the stations considerably wrecked by the violence of the wind. The whole length of line from Atmora, $16\frac{1}{2}$ miles from Bareilly, to Baheri, $31\frac{1}{2}$ miles, a distance of upwards of fifteen miles, was strewn, not only with branches torn off from adjacent trees, but many of the trees themselves. In consequence of the line having to be cleared of these obstructions, the Naini Tal train, which should have arrived at Bareilly junction at 3-20, did not reach that station till half-past 7, being upwards of four hours and ten minutes late. The Moradabad train is also late; it ought to have arrived here at 3-44 P. M. and is not here yet 20 past 8.

Ghaziabad, 4th May.

The hailstones which fell here during the storm of the 1st were of phenomenal size. Some selected ones, to which accredited witnesses testify, were three and four inches in diameter and weighed from four to eight ounces. Those of medium size were as large as cricket balls. They were not quite round, but spheroidal, and the rebound of the large ones was not less than fifty feet. A gentleman, many years a resident here, had never seen anything like it.

Shahjahanpur, 4th May.

An exceedingly violent hurricane burst over the city and station of Shahjahanpur on the evening of the 1st. The wind began to rise about 4 o'clock P. M., and blew violently from an easterly direction, when on a sudden it veered round to a westerly direction. The consequence of this sudden change in the direction of the current of air must have been a considerable downward pressure of the opposing currents; and the trees, both through the city, the civil station, and cantonment, suffered very much. I arrived at the Shahjahanpur Railway station from Bareilly at 11 P. M. There was not a single *tikka gharry** in attendance, owing to trees and branches of trees of all sizes lying across the road from the Railway station to the city and all round. In going round the city on the morning of the 2nd I found enormous trees and branches strewed about in all direction, and many roofs and walls crushed in by them.

* *Thika gāri*, hackney carriage.

The thatched roofs of the three porticoes of the Government Native School were blown clean off. I hear several people in the city have been killed from the falling in of roofs and walls, which have been crushed in and knocked down by the falling branches and trees. The kutcherry* compound had an appearance as if the trees had been cut down for the purpose of forming an *abattis* to stand a siege. The oldest inhabitant of Shahjahanpur says he cannot remember ever to have experienced so severe a hurricane. The accounts from Moradabad (native accounts) are most wonderful, even in the way of imagination. One is that that there were several shocks of earthquake at the time the tempest occurred in that station, and that here and there cracks appeared in the earth. Another, that a party of five hundred souls forming a wedding procession between Moradabad and Powajan were caught in the storm, and all perished, the bridegroom amongst them, with the exception of five men. A third, that many poor people who were watching their cucumber, melon, and water-melon beds in the vicinity of the Ramgunga River were overwhelmed in the dense columns of sand-dust borne along by the storm-wave, and being daily dug out and carried into Moradabad for identification. The weather to-day, the 4th of May, is quite cool, needing no punkha even in the middle of the day.

* Magistrate's Court.



VII.—*The Geometric Interpretation of Monge's Differential Equation to all Conics.*—By ASUTOSH MUKHOPADHYAY, M. A., F. R. A. S., F. R. S. E.

[Received May 22nd;—Read June 6th, 1888.]

CONTENTS.*

- § 1. Historical introduction.
§ 2. Geometric interpretation.

§ 1. *Historical Introduction.*

Before proceeding to give the true geometric interpretation of Monge's differential equation to all conics, which I have recently discovered, and which it is the object of this paper to announce and establish, a brief survey of the past history and present position of the problem may not be wholly unprofitable. In the first place, then, we remark that the differential equation of all conics was, more than three-quarters of a century ago, first discovered by the illustrious French mathematician Gaspard Monge, and published by him in 1810.† It should be remembered that, in his paper, Monge does not furnish us with any clue to the method by which, from the integral equation of the conic, he derived the differential equation which now appropriately bears his name: neither is there any attempt at a geometric interpretation; it is simply stated that the differential equation to all conics of the second order as obtained by the elimination of the constants from the equation

$$Ay^2 + 2Bxy + Cx^2 + 2Dy + 2Ex + 1 = 0$$

is

$$9q^2t - 45qrs + 40r^3 = 0,$$

where, as usual,

$$p = \frac{dy}{dx}, \quad q = \frac{d^2y}{dx^2}, \quad r = \frac{d^3y}{dx^3}, \quad s = \frac{d^4y}{dx^4}, \quad t = \frac{d^5y}{dx^5};$$

and this statement is followed by a verification that the differential equation of all circles

$$(1 + p^2)r = 3pq^2$$

leads, on differentiation, to the differential equation of all conics.

After Monge's paper, we come to the following statement made by the late Dr. Boole:‡

* For a full analysis of this paper, see the *Proceedings* for 1888, pp. 157-158; see also *Nature*, vol. xxxviii, p. 178.

† Sur les Equations différentielles des Courbes du Second Degré. (Bulletin de la Soc. Philom. Paris, 1810, pp. 87-88; Corresp. sur l'Ecole Polytech. (Hachette) Paris, 1809-13, t. ii, pp. 51-54).

‡ Differential Equations, Fourth Edition, pp. 19-20.

"Monge has deduced the general differential equation of lines of the second order, expressed by the algebraic equation

$$ax^2 + bxy + cy^2 + ex + fy = 1.$$

It is

$$9 \left(\frac{d^2y}{dx^2} \right)^3 \frac{d^5y}{dx^5} - 45 \frac{d^2y}{dx^2} \frac{d^3y}{dx^3} \frac{d^4y}{dx^4} + 40 \left(\frac{d^3y}{dx^3} \right)^2 = 0$$

But, here our powers of geometrical interpretation fail, and results such as this can scarcely be otherwise useful than as a registry of integrable forms."

The subject seems to have attracted the notice of English mathematicians from the above statement of Boole, and, during the thirty years which have elapsed since these remarks were first made, there appear to have been two attempts to interpret geometrically Monge's differential equation to all conics. The first of these propositions, by Lieut.-Col. Cunningham, is that the eccentricity of the osculating conic of a given conic is constant all round the latter.* The second proposition, by Prof. Sylvester, is that the differential equation of a conic is satisfied at the sextactic points of any given curve.† I have elsewhere considered in detail both these propositions, and I have fully set forth my reasons for holding that neither of them is the true geometric interpretation of Monge's differential equation to all conics.‡ In fact, as I have already remarked, there are two tests which may be applied if we wish to examine whether a proposed interpretation of a given differential equation is relevant or not, *viz.*,

1st. The interpretation must give a property of the curve whose differential equation we are interpreting; in fact, it must give a geometrical quantity which vanishes at every point of every curve of the system.

2nd. The geometrical quantity must be adequately represented by the differential equation to be interpreted.

Lieut.-Col. Cunningham's interpretation cannot be accepted as it satisfies neither of the tests; it fails to give such a property of all conics as would lead to a geometrical quantity which vanishes at every point of every conic; moreover, it is not adequately represented by the differential equation to be interpreted, inasmuch as it is really the geometric interpretation of the differential equation

$$\frac{(e^2 - 2)^2}{1 - e^2} = \frac{T_0^2}{9q^4U},$$

* Quarterly Journal of Mathematics (1877), vol. xiv, pp. 226-229.

† American Journal of Mathematics (1886), vol. ix, pp. 18-19.

‡ Journal, A. S. B. (1887), vol. lvi, part ii, pp. 134-145; P. A. S. B. (1887), pp. 185-186; P. A. S. B. (1888), pp. 74-86.

where

$$\begin{aligned} T_0 &= (1+p^2)(3qs-4r^2) - 3q^2(2pr-3q^2) \\ U &= 3qs-5r^2, \end{aligned}$$

and, by actual calculation, I have proved this differential equation to be one of the five independent first integrals of the Mongian equation.* Professor Sylvester's interpretation is, similarly, wholly out of mark, as satisfying the second test but not the first, inasmuch as it gives a property not of all conics but of an extraneous curve.

So far my criticism has been purely negative, as I have confined myself to the statement that the true interpretation of the Mongian equation still remains to be found. I now proceed to give what I believe to be the long sought for interpretation of the differential equation to all conics.

§ 2. Geometric Interpretation.

Consider the conic of closest contact at a given point of any curve; refer the system to rectangular axes through any origin; then, if x, y be the coordinates of the given point, and α, β those of the centre of aberrancy, I have already established the system of equations†

$$\begin{aligned} \alpha &= x - \frac{3qr}{3qs-5r^2}, \\ \beta &= y - \frac{3q(pr-3q^2)}{3qs-5r^2}. \end{aligned}$$

If now $d\psi$ be the angle between two consecutive axes of aberrancy, ρ the radius of curvature, and ds the element of arc, of the "aberrancy curve" (which is the locus of the centre of aberrancy), we have

$$\begin{aligned} ds^2 &= d\alpha^2 + d\beta^2 \\ \rho &= \frac{ds}{d\psi}. \end{aligned}$$

Now, from the above expressions for α, β we get easily

$$\begin{aligned} \frac{d\alpha}{dx} &= \lambda T, \\ \frac{d\beta}{dx} &= \mu T, \end{aligned}$$

* See *Nature*, vol. xxxviii, pp. 318-319, where Lient.-Col. Cunningham substantially acknowledges the correctness of my criticism.

† See my paper "On the Differential Equation of all Parabolas", *J. A. S. B.* (1888), vol. lvii, pt. ii, pp. 316-332; cf. p. 324.

where

$$\lambda = \frac{r}{(3qs - 5r^2)^{\frac{1}{2}}}$$

$$\mu = \frac{rp - 3q^2}{(3qs - 5r^2)^{\frac{1}{2}}},$$

$$T = 9q^2t - 45qrs + 40r^3.$$

Therefore

$$\left(\frac{ds}{dx}\right)^2 = \left(\frac{d\alpha}{dx}\right)^2 + \left(\frac{d\beta}{dx}\right)^2 = (\lambda^2 + \mu^2)T^2,$$

and

$$\rho = \frac{ds}{d\psi} = \frac{ds}{dx} \frac{dx}{d\psi} = (\lambda^2 + \mu^2)^{\frac{1}{2}} T \cdot \frac{dx}{d\psi}.$$

But

$$\frac{dx}{d\psi} = \frac{dx}{d\omega} \cdot \frac{d\omega}{d\psi},$$

and, as proved in my former paper,* we have

$$\frac{d\omega}{dx} = \frac{q}{1+p^2},$$

and

$$\frac{d\psi}{d\omega} = \frac{9\rho^2 + 4\left(\frac{d\rho}{d\omega}\right)^2 - 3\rho \frac{d^2\rho}{d\omega^2}}{9\rho^2 + \left(\frac{d\rho}{d\omega}\right)^2},$$

where

$$9\rho^2 + \left(\frac{d\rho}{d\omega}\right)^2 = \frac{(1+p^2)^4}{q^6} \left\{ r^2 + (rp - 3q^2)^2 \right\},$$

$$9\rho^2 + 4\left(\frac{d\rho}{d\omega}\right)^2 - 3\rho \frac{d^2\rho}{d\omega^2} = \frac{(1+p^2)^5}{q^6} (3qs - 5r^2),$$

so that

$$\frac{d\psi}{d\omega} = \frac{(1+p^2)(3qs - 5r^2)}{r^2 + (rp - 3q^2)^2}.$$

Hence, finally,

$$\frac{dx}{d\psi} = \frac{r^2 + (rp - 3q^2)^2}{q(3qs - 5r^2)},$$

and

$$\rho = \frac{\left\{ r^2 + (rp - 3q^2)^2 \right\}^{\frac{3}{2}}}{q^2(3qs - 5r^2)^{\frac{3}{2}}} \cdot T.$$

* J. A. S. B. (1888), vol. lvii, pt. ii, pp. 316—332; cf. p. 322.

1889.] A. Mukhopadhyay—*Monge's Differential Equation.*

This result may also be obtained without calculating the value $\frac{dx}{d\psi}$. For, α, β being the coordinates of the centre of aberrancy, we have

$$\rho = \frac{\left\{ 1 + \left(\frac{d\alpha}{d\beta} \right)^2 \right\}^{\frac{3}{2}}}{-\frac{d^2\alpha}{d\beta^2}},$$

and

$$\begin{aligned} \frac{d\alpha}{d\beta} &= \frac{d\alpha}{dx} \frac{dx}{d\beta} = \frac{\lambda}{\mu}, \\ \frac{d^2\alpha}{d\beta^2} &= \frac{d\alpha}{d\beta} \frac{d}{dx} \left(\frac{d\alpha}{d\beta} \right) = \frac{1}{\mu T} \frac{d}{dx} \left(\frac{\lambda}{\mu} \right) \\ &= \frac{1}{\mu T} \frac{d}{dx} \left(\frac{r}{pr - 3q^2} \right) = -\frac{q}{\mu T} \frac{3qs - 5r^2}{(pr - 3q^2)^2} \\ &= -\frac{q}{T} \frac{(3qs - 5r^2)}{(pr - 3q^2)^3}. \end{aligned}$$

Substituting, we get, as above,

$$\rho = \frac{\left\{ r^2 + (pr - 3q^2)^2 \right\}^{\frac{3}{2}}}{q (3qs - 5r^2)^3} T.$$

This, therefore, is the most general expression for the radius of curvature of the "aberrancy curve" of any given curve. Now, when

$$T = 0$$

we have

$$\rho = 0.$$

But

$$T = 0$$

is known to be the differential equation to all conics; hence, obviously the geometric interpretation of Monge's differential equation to conics is as follows:—

The radius of curvature of the aberrancy curve vanishes at every point of every conic.

This geometrical interpretation will be found to satisfy all the tests which every true geometrical interpretation ought to satisfy, and I believe that we have at length got here the interpretation which has been sought for by mathematicians during the last thirty years, ever since Boole wrote his now famous lines.*

19th May, 1888.

* For some remarks (which, however, seem to me to be very weak) on this interpretation by R. B. H. (Hayward?), see *Nature*, vol. xxxviii, pp. 197, 516, 619.

VIII.—*Description of a Stag's head allied to Cervus dybowskii* Tac., procured from the Darjeeling Bazaar.—By W. L. SLATER, Deputy Superintendent of the Indian Museum.

[Received 27th Feb.,—Read 6th March, 1889.]

(With Plate XI.)

Some months ago a stag's head was sent to the Museum by Mr. Dunne, who wished the head to be mounted to hang up in his hall.

Mr. Fraser, the 2nd assistant to the Superintendent, on examining the head, at once saw that it was something out of the common, that it was the head of neither Sambur, Tibet deer, or Kashmir deer, and he drew my attention to the fact.

On my writing to Mr. Dunne he most kindly consented to exchange the head for one of a Sambur, and further informed me that he had bought the head in the bazaar at Darjeeling, but that, beyond that, he knew nothing about it.

I sent the head to Simla to Mr. Hume in order that he might compare it with the heads in his own magnificent collection; Mr. Hume wrote to me telling me that he had nothing like it in his collection, but drew my attention to the description of *Cervus dybowskii* of M. Taczanowski published in the Proceedings of the Zoological Society for 1876, and further said that he thought it probable that the specimen in question was either identical with, or nearly allied to, that interesting species.

I propose first of all to describe the head and afterwards to make some remarks on its affinities.

The head which I exhibit this evening, and of which the accompanying plate gives a good idea, is at once distinguished by the entire absence of the second brow antler which is so characteristic of the Elaphine group of the genus *Cervus*.

With regard to the skull, the most noticeable feature is the curious expansion of the nasal bones, which spread out over the suborbital vacuity, causing the vacuity to be much smaller than in either the Sambur or the Tibetan or Kashmir stag; the suborbital pit too is larger than that of the Kashmir or Tibetan stag (*Cervus cashmeerianus* and *C. affinis*), but is smaller than that of the Sambur (*C. aristotelis*); the other noticeable points in the skull are the form of the auditory bulla and the molar teeth.

The auditory bulla is distinctly Elaphine; as in the Tibetan and Cashmir stags, it is small, compressed, and rugged, and not swollen, while the bulla of the Rusine stags is much swollen and quite smooth.

The molar teeth have three well marked columns on the external sur-

face of each tooth; the intermediate ones, however, are not so well marked; this also shows an Elaphine rather than a Rusine affinity.

The antlers are placed on moderate pedestals, the brow antler springs at almost a right angle to the beam, and subsequently is slightly turned up at the point; half way up the beam there is another anteriorly directed tine, that on the right antler being considerably shorter than on the left; above this, the median tine, there are two more anteriorly directed tines, the lower one of considerable length, the upper one short, but surpassing the distal unbranched end of the beam in length.

The horns are thin and slender, marked with longitudinal ridges, and rather worn, so that they were probably soon about to be shed; the animal was therefore probably killed in early spring or late winter, if there is any analogy to be drawn from the time of horn-shedding of the Kashmir stag.

The head when it arrived had been preserved with the skin on; this was carefully removed and cured.

The rhinarium agrees with that of the Rusine rather than with that of the Elaphine group; it is fairly extensive, but does not quite surround the nostrils; the pre-narial portion, forming the isthmus between the narial and labial portion, is rather narrow; but the infra-narial portion, the absence of which is so marked in the Elaphine group, is here well developed.

The hair on the head is rather coarse, it is dark brown in colour, each hair being provided with a subterminal band of yellow, so that the general appearance of the fur is of a speckly yellow; the hair round the rhinarium and upper lip is white.

The above description leaves little or no doubt that the animal belongs to the group *Pseudaxis* as defined by Sir V. Brooke in his well-known paper on the Cervidæ (P. Z. S. 1878, p. 907).

There are only two species of the group *Pseudaxis* which approach our specimen in size; these are *O. mantchuricus* and *O. dybowskii*; of these *O. mantchuricus*, though figured, is nowhere very fully described. *Cervus dybowskii* is well described by Taczanowski (P. Z. S. 1876, p. 25), and seems to agree with our specimen in nearly all respects; there are, however, only 8 points to the antlers described by Taczanowski, while our specimen possesses 10 points; in every other respect except size our specimen agrees with the description given by M. Taczanowski; the colour speckly brown, the white muzzle, and also the curiously shaped nasals, which are clearly shown in the wood-cut accompanying the description, though not mentioned in the text.

In size the *Cervus dybowskii* seems slightly inferior to our specimen, as will be seen by the measurements in inches of the two specimens given

below ; in the case of *C. dybowskii* the centimetres have been reduced to inches.

	Darjeeling specimen.		<i>C. dybowskii</i> .
	Right antler	left antler	
Length of antlers along the curve, ...	36.0	35.5	22.0
Between the antlers at their base, ...	3.5		3.5
Spread, ...	32.0		16.0
Length of basal tine, ...	7.5	8.0	5.8
Length of 2nd tine, ...	8.0	12.5	5.0
Length of 3rd ditto, ...	11.5	9.5	5.0
Length of 4th ditto, ...	3.5	4.5	—
Tip of beam, ...	2.0	2.5	—

The following are the usual skull measurements given in inches :—

Length of skull from tip of premaxillaries to the occipital condyle, ...	... 13.75
The palate from the tip of the premaxillaries to the posterior nares, ...	... 8.0
Extreme breadth behind the orbits, ...	... 7.5
Length of the three molars, ...	... 2.5
Width of palate between the posterior molars, ...	... 2.75
Length of the suborbital pit, ...	... 2.0

The types of *Cervus dybowskii* were procured by M. Dybowski in Southern Ussuri, which lies to the south of the Amur river and to the north of Vladivostok, the great Russian Port in Japanese seas.

The specimen which I here exhibit was, as I have mentioned above, bought by Mr. Dunne in the Darjeeling bazaar, so that there is absolutely no evidence as to whence the stag came, but it seems probable that it was brought from Tibet, and, as the skin and horns were in good condition, it does not seem likely that it came from a very distant part of Tibet.

If therefore the stag in question really does turn out to be specifically identical with the stag from Ussuri-land, the range of the *Cervus dybowskii* must be very great, reaching from Tibet all through Western China and Manchuria to Ussuri, in which case it is very remarkable that it should not have been oftener procured by scientific collectors.

IX.—*On the Volatility of some of the compounds of Mercury and of the Metal itself.*—By ALEX. PEDLER.

I propose only in the present paper to add a few facts to those already known on the subject of the volatility of mercury and of some of its compounds. Popularly, the liquid metal mercury, or quicksilver, may be considered to be a typical case of a liquid which is non-volatile. This, however, is not the case, and the volatility of mercury has been the subject of many researches. Faraday* was one of the first to notice that mercury is sensibly volatile even at the ordinary temperature of the air, and he states that this is the case between 15.5° and 27° , but not at 6.7° , both in spaces filled with air and *in vacuo*. This volatility of mercury was proved by suspending gold leaf for 2 months in a vessel over mercury, when the leaf became amalgamated. This volatility is also proved by the old process of daguerreotyping, and by the fact that, if a current of electricity is passed through a Torricellian vacuum or through Geissler's tubes which are being exhausted with a mercurial pump, the spectrum of mercury can be seen. Numerous writers such as Regnault,† Berthelot,‡ Ramsay and Young,§ Karsten,|| Merget¶ and McLeod** have all proved the volatility of mercury. Merget in particular has shown that even at a temperature of -44° , it possesses a sensible vapour tension, while McLeod has been able to estimate the actual weight of mercury which existed in the form of vapour in a vessel at the ordinary temperature of the air. In one experiment it was found that in a flask 1.9 litres capacity the weight of mercury vapour was only the very small amount of 0.00009 gram.

In India, where we deal usually with atmospheric temperatures considerably above those where all the published experiments on this subject have been made, it may naturally be expected that the volatility of mercury will be a very appreciable quantity. This fact has lately been proved to me in a very striking way. At Buxar (Behar) there is a Government Meteorological Observatory where there is a mercurial barometer suspended on the inner wall of a house, but immediately opposite a doorway, and in such a position that though exposed to the

* Faraday, Schw. 32 482, and Pogg. 9, also Watts's Dictionary of Chemistry, article on Mercury.

† Compt. rend. lxxiii.

‡ Ditto ditto 100, 13, 26-1328.

§ Journ. Chem. Soc. Trans. 1886, 37-50.

|| Pogg. 7, 245.

¶ Compt. rend. lxxiii, 1356.

** Chem. News, 48, 251.

reflected glare from the ground, it is protected from the actual direct rays of the sun. It was not receiving any direct rays of the sun at the time the following facts were observed, and its position is such that, except for perhaps a very brief period during the winter season, it is never reached by the sun's rays. This observatory was inspected on October 23rd, 1888, and in the Torricellian vacuum of the barometer, at some little distance above the surface of the mercury in the tube and immediately behind the usual position of the vernier, I found a deposit of from 100 to 120 small globules of mercury ranged all round the inside of the tube, the size of which averaged about half that of an ordinary pin's head. I could not actually determine the weight of mercury which had thus distilled upwards, but I estimated it roughly to have been more than half a gramme. The Superintendent of the observatory has informed me that the deposit of mercury was first noticed on September 20th, 1888, and that after having been removed and the instrument put right by me on October 23rd, the deposit had again commenced to form on the 15th of November. In this case then it is proved that mercury can at the temperature of Buxar for the period named give off sufficient vapour *in vacuo* to effect an actual slow distillation. The meteorological elements for Buxar in October 1888, were:—

mean maximum temperature $90.1^{\circ}\text{F} = 32.3^{\circ}\text{C}$

mean minimum temperature $70.0^{\circ}\text{F} = 21.1^{\circ}\text{C}$

and the mean temperature of the solar radiation thermometer in Behar in October was about $139.1^{\circ}\text{F} = 59.5^{\circ}\text{C}$.

The cause of the mercury collecting in the portion of the vacuum part of the barometer tube shaded by the vernier is easily understood, for it is this part which is protected from the glare from the ground heated by the sun, and will therefore be at a slightly lower temperature than the rest of the tube. The only other cause which could be acting in this case would be the difference between the highly illuminated and shaded parts of the tube. If this were the cause it would show that the distillation was caused by the action of light, but this alternative can probably be neglected.

The fact of this slow distillation of mercury in a barometer tube should be carefully noted by meteorologists, particularly in tropical countries. In the case in question the barometer was one of Fortin's principle, and the presence of the globules of distilled mercury did not introduce any error into the barometric readings, but if the instrument had been constructed on the Kew principle, as is the case very largely now with barometers, the presence of this sublimed mercury would have entirely vitiated the accuracy of the readings of the barometer.

The volatility of certain compounds of mercury has also been brought to my notice in the course of a number of experiments which I have been carrying out on the action of light on various chemical compounds. The usual method of experimenting has been as follows:—A small quantity of a compound is placed in a glass tube sealed at one end, and if a solid, a small plug of cotton wool is placed above it. The tube is then considerably narrowed before the blowpipe at about 3 to 4 inches from the closed end, and above the constricted part a stick of caustic soda or a piece of metallic sodium or other reagent is placed, to decompose or combine with any vapour which may be evolved by the compound which is being tested. The tube is then rendered vacuous by a Sprengel pump and hermetically sealed, the whole tube being 8 to 10 inches long. It is afterwards exposed to the sunlight or kept in the dark as the case may require.

The following mercuric compounds have been tested:—mercuric oxide, mercuric cyanide, mercuric iodide, mercuric oxalate, mercuric chloride (corrosive sublimate), and mercuric bromide. Of the mercurous salts only mercurous chloride was tested, for it is well-known that such compounds as mercurous oxide, mercurous iodide, etc. are very readily decomposed.

Red mercuric oxide was placed in a sealed tube *in vacuo* with a few freshly cut pieces of metallic sodium in the upper part of the tube. The experiment was commenced in March 1887, and the tube was exposed daily to sunlight for about a year. On examination the pieces of sodium were all found completely covered with a decided layer of oxide, and on removing the oxide, part of the sodium surfaces appeared like a piece of sodium amalgam. After acting on the sodium with water a considerable number of distinct and moderate sized globules of mercury were obtained.

The oxide of mercury, which was of a bright red colour at the commencement of the experiment, was examined. It was of a dark chocolate brown colour, and on examination it was found to consist of unchanged red mercuric oxide with a distinct quantity of mercurous oxide. Metallic mercury was tested for but none could be detected. The experiment therefore proves conclusively that mercuric oxide is feebly volatile at temperatures such as those obtained in sunlight, for the only way in which the mercury could have passed to the sodium is by volatilization of the oxide. No metallic mercury was found in the oxide after the action of sunlight, and therefore no upward distillation of mercury as such could have happened.

Observations have already been made showing that mercuric oxide when exposed to sunshine turns black superficially and partially de-

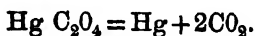
composes. Guibert* states that the decomposition yields mercury and oxygen, while Donovan* states that mercurous oxide and oxygen are formed. Donovan's explanation therefore of the reaction appears to be the correct one, and not that advanced by Guibert.

Jacob Myers (Deut. Chem. Ges. Ber. VI. 11) has also shown that mercuric oxide apparently commences to decompose *in vacuo* in a very feeble manner at about 150°C, but that even at 240° the tension of the evolved oxygen is only 2 m.m., but it is clear that the phenomenon described in the previous experiments is quite different from that alluded to by Myers.

Mercuric cyanide *in vacuo* appeared quite non-volatile, and, even after exposure to the direct rays of the sun for a month in the hot season of the year, the compound itself seemed to be quite unaltered.

Mercuric iodide appeared also quite non-volatile at ordinary air temperatures *in vacuo*, even when exposed to the rays of the Indian sun, and it also appeared practically unchanged in composition by the direct action of sunlight, and, though there was a slight darkening in colour under the influence of light, the change was to a great extent temporary, and disappeared when the iodide was exposed to the air.

Mercuric oxalate was exposed to the direct rays of the sun *in vacuo* for seven and a half months during the hot season of the year. There was no evidence whatever of the substance being volatile, but the colour of the salt darkened rapidly under the influence of the sun and changed to a deep grey. The grey mass after treatment with solution of potassic cyanide, and afterwards with ammoniac chloride, left a black residue from which globules of mercury were obtained by the usual process, and which black residue gave all the tests for metallic mercury. This salt, though not volatile at ordinary temperatures *in vacuo*, appears therefore to decompose by sunlight according to the equation:—



Mercuric chloride was the next salt tested, and this yielded rather important results. One of the experiments may be described as follows:—On March 6th, 1886, a glass tube $\frac{7}{8}$ of an inch internal diameter was filled at its closed end with 10·876 grams of pure mercuric chloride. It was drawn out, &c., in the usual manner, and a stick of caustic soda placed in the upper part of the tube, which was then rendered vacuum and hermetically sealed. After sealing, it was daily exposed to the sun's rays with the end of the tube containing the caustic soda upwards. After a few days a grey deposit of metallic

* Gmelin's Chemistry, Vol. VI, p. 10.

mercury commenced to form on the surface of the caustic soda, and this gradually increased until the whole surface of the caustic soda and part of the interior surface of the glass was covered with a grey film. The experiment was allowed to go on till June 10th, 1887, when the tube was opened and examined. The mercury salt in the lower end of the tube was weighed, and found to be 10·8628 grams and had therefore lost 0·0132 gram. The mercury salt was examined, and was found to have been partly reduced to mercurous chloride (calomel), and 0·018 gram of this salt had been produced. This calomel when examined under the microscope was of a distinct crystalline nature, and crystals belonging to the usual form for calomel* were found; these crystals also answered to all the tests for calomel. No free mercury was found in the corrosive sublimate.

The amount of mercury which had been deposited in the upper part of the tube, and which was due to the decomposition of the vapour of the mercuric chloride was also estimated, and was found to weigh 0·0112 gram, or very nearly the amount which would be calculated from the loss of weight, etc. of the mercuric chloride. It is clear therefore that mercuric chloride is very decidedly volatile at ordinary air temperatures *in vacuo* and when exposed to sunlight, and from a nearly circular surface of the powdered salt about $\frac{1}{2}$ inch in diameter a very appreciable weight of mercuric chloride had evaporated and had passed up a tube nearly six inches in length, while a further appreciable weight of the mercuric chloride had changed into mercurous chloride.

To test whether this decided volatility was in any way facilitated by the strong light used in the experiment, another tube $\frac{1}{2}$ inch diameter had been similarly prepared, but had been kept in the dark. This experiment was started on April 19th, 1887. The action in this case did not commence so rapidly as in the previous case. After a month only about $\frac{1}{3}$ of an inch of the lower end of the stick of caustic soda was covered with the deposit, and the deposit gradually but slowly increased. The tube was opened on January 2nd, 1889, and the incrustation was found of a yellow to a yellow brown colour. The deposit was examined under the microscope, and no metallic mercury could be detected. The deposit was weighed, and found to be only 0·0016 gram., and it was found to consist practically entirely of mercuric oxide (HgO).

Thus it is clear that the mercuric chloride is volatile at ordinary air temperatures, but the volatility appears to be increased by the direct action of light. The reactions in the two cases are also slightly different,

* Watts's Dict. Chem Vol II, P. 135 fig 237.

for, while in full sunshine mercury only is deposited by the action of the caustic soda on the mercuric chloride vapour, in the dark mercuric oxide is deposited, and the reaction appears to be $\text{Hg Cl}_2 + 2\text{NaHO} = \text{HgO} + \text{H}_2\text{O} + 2\text{NaCl}$.

So far as I have been able to ascertain the partial decomposition and volatility of solid mercuric chloride at ordinary atmospheric temperatures and under the influence of sunlight have never previously been noticed. J. Davy* apparently investigated the properties of mercuric chloride, and says the salt does not suffer decomposition when exposed in the state of powder to sunshine. The salt is also well-known to be volatile at high temperatures, for it melts at 265° and boils at 295° , but beyond some vague statements that mercuric chloride is more volatile than mercurous chloride, which is itself volatile only at about a red heat, no precise statement is made that I can find, that this body is at all volatile when in the solid state or at any temperature below its melting point.

Solutions of mercuric chloride are known to undergo slight change when exposed to sunlight, and the reaction is generally said to yield mercurous chloride, oxygen, and hydrochloric acid,† or by others oxychloride and hydrochloric acid. In order to verify this point some experiments were made by exposing such solutions to the rays of an Indian sun. After exposure for about six months a solution of the mercuric chloride gave a small quantity of a grey or greyish white precipitate, and also some prismatic crystals of moderate size, which were colourless and transparent. Both the crystals and the greyish white powder were found to be mercurous chloride. No metallic mercury could be detected. The decomposition of the solution of mercuric chloride under the influence of sunshine is therefore parallel to the decomposition of the salt in the solid state as above described. The decomposition of the mercuric chloride is of course in both cases very incomplete.

It has been proved by Hannay‡ in his paper on "new processes of mercury estimation, &c.," that when a solution of mercuric chloride is evaporated a portion of the salt is volatilized with the aqueous vapour, and he made some quantitative experiments and showed, that in one case over 5 per cent. of the salt could thus pass away. He also states (p. 572) "that when solutions of mercuric chloride are evaporated or boiled in a room even when well ventilated, the salt which is thus thrown into the atmosphere is very injurious to the human system, in fact all

* Gmelin's Chemistry, Vol. 6, P. 55.

† Gmelin's Chemistry, Vol. 6, P. 55.

‡ Journ. Chem. Soc. 1873, P. 565-575.

the symptoms of mercury poisoning are strongly manifested." If, however, the solution of mercuric chloride contains hydrochloric acid or apparently other acids also, the salt does not volatilize at all when evaporated, and it would appear to be only when pure solutions are evaporated that this volatilization takes place.

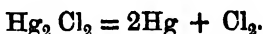
The power which steam has of carrying forward vapours of other bodies which under ordinary circumstances are fixed or difficultly-volatile is well-known, and there is thus perhaps nothing very surprising that the vapour of a body which boils at 295° should be carried over by steam, but the fact that the addition of an acid such as hydrochloric to the solution renders the salt non-volatile with steam requires explanation. The possible reason why the volatility then ceases may perhaps be found in the fact proved by A. Ditte* that hydrochloric acid has the power of forming direct crystallizable compounds with mercuric chloride such as $\text{HgCl}_2 \cdot 2\text{HCl} \cdot 7\text{H}_2\text{O}$, &c. The behaviour of mercuric chloride in solution in water in being volatile and in yielding mercurous chloride in sunlight is thus almost parallel to the behaviour now observed with mercuric chloride in the solid state.

The next mercuric salt examined was mercuric bromide, which was placed in a sealed tube *in vacuo* with sodium hydrate in the upper part of the tube. After exposure to sunlight for about a year it was found that the end of the stick of sodium hydrate nearest the bromide for a space of about an inch had become coated with an incrustation. The incrustation was very thick at the end of the stick and of a dark grey brown colour; it was also tolerably thick over at least six-tenths of an inch of the hydrate and the remaining part was thinner and of a brown colour. This incrustation was examined and was found to consist almost entirely of mercuric oxide, of which there was rather a large amount, but a few small globules of metallic mercury were also detected. The mercuric bromide still in the tube was examined, and it was found that only a very few needle-shaped crystals were left after the mass was treated with boiling water. These needle-shaped crystals were apparently mercurous bromide but the quantity examined was small.

The action of mercuric bromide in sunlight and *in vacuo* is therefore almost parallel with that of mercuric chloride, but the bromide is sensibly less volatile at the ordinary temperature of the air than the chloride is. I have not been able to find any determination of the melting and boiling point of the bromide, but it is known that the salt can be sublimed, but at a higher temperature than the chloride.

* Compt. rend. 92, 353-355.

Very few of the mercurous compounds lend themselves to the detection of whether they are volatile at the ordinary temperature of the air or not, for it is known that many of them under the influence of light or of sunlight decompose. This is the case with mercurous oxide, iodide, &c. An attempt was, however, made to determine whether calomel would be volatilized *in vacuo* in sunlight; and, in the case of some experiments conducted in a manner similar to that previously described, it was shewn that a very small deposit of mercury was formed on the sticks of caustic soda. On examining, however, the mercurous chloride remaining in the tube after being exposed for some months to sunlight, it was found that the salt was of a grey instead of the original white colour. On testing the calomel carefully no trace of mercuric chloride could be detected, but free mercury was found in distinct quantities. The decomposition which therefore had taken place under the influence of sunlight was



As mercury had been itself formed by the decomposition of the mercurous chloride, and as it is well-known that mercury is volatile, the presence of the mercury on the caustic soda is a little ambiguous, but from the manner in which the deposit took place, and from the similar nature of the action to that of mercuric chloride, which could be watched as the experiment went on, it appeared to be highly probable that the mercurous chloride itself was volatile in an exceedingly feeble manner at the temperatures experimented with.

As in the above experiments no actual record of the temperature could be given day by day or hour by hour, it is perhaps desirable that the general atmospheric temperatures during the experiments should be stated. All the experiments were made in Calcutta, where the average maximum monthly temperature during 1888 varied from 97° F. or 36° C. in June to 74° F. or 23° C. in January, while the highest maximum air temperature was 107·2° F. or 40·7° C. The average minimum daily temperature on the other hand varied from 80° F. or 27° C. in June to 55° F. or 13° C. in December. The average monthly temperature of solar radiation in Calcutta in 1888 also varied from about 152° F. or 67° C. in May to 124° F. or 51° C. in January.

The very decided volatility of mercury and of such of its compounds as mercuric oxide, mercuric chloride, mercuric bromide, and perhaps even mercurous chloride in such a climate as Calcutta having been proved, it remains to give a word of warning to all those who use these substances in any way. In India, in particular, mercuric chloride is used rather freely, for many of the preparations which are largely used to preserve books from the attacks of insects contain mercuric

chloride as the active ingredient. Preparations, too, for preserving wood, fabrics, &c. and for protecting them from white ants and other destructive insects and animals frequently contain this substance, and it is but fair to state that mercuric chloride fulfils such purposes most effectually. Also some vermin and rat-poisons contain mercuric chloride as the active ingredient. Again, within the last few years I believe the use of mercuric chloride as an antiseptic in surgical and other cases has spread rapidly, and Lister* uses, I believe, a kind of gauze containing one per cent. of this salt or even cotton wool charged with five per cent. of it as a dressing in surgical cases. Mercuric chloride has undoubtedly a wonderful power of destroying germs of various kinds, and a solution of one part in 20,000 of water is said to effectively kill germs such as those of anthrax. In all such cases, however, it must be borne in mind that mercurial vapours may be under certain circumstances generated, and in persons who may be peculiarly susceptible to mercurial poisoning very unpleasant effects may be produced. Two cases of mercurial poisoning in Europe which are on record can in my opinion only be explained by the volatility of mercurial chloride which has now been proved.

The two cases are described by H. Hager† (who is I believe connected with the Imperial Health Office, Berlin) and the following is a translation of his description :—‡

“What sad consequences breathing and living in rooms, to the walls of which atoms of mercuric chloride adhere may have, the writer intends to illustrate by two examples, the first of which will be sufficient to condemn the use of the substance as a disinfectant. ☞

“An apothecary, Mr. Z., addressed the writer with reference to a kind of disease from which he had been suffering for some years, and of which no medical advice had been able to relieve him. His gums were dreadfully livid in appearance, his teeth had lost their hold and had fallen out one after the other, he had lost his hair, &c., &c.; Mr. Z. complained also of a peculiar weakness in his stomach and had lost all his former strength. Symptoms of mercurial poisoning were at once recognized. The advice which was given to Mr. Z. was to search for the seat of the poison, to take up the boards of the floor and examine the sand under the boards optically and chemically, &c. The advice was followed but the search proved abortive. Finally, however, it was found that a wooden staircase had been attacked by fungi some years

* British Med. Journ. October 23rd, 1884.

† *Chemisches Central Blatt* No. 17 and 18, 1886.

‡ I am indebted for these references to Mr. P. Bruhl.

previously, and to save it from destruction it had been painted with oil-paint to which some corrosive sublimate had been added. The staircase was removed, and soon the normal conditions returned. The other inhabitants had suffered much less or not at all; from which it appears that some persons are more liable to mercurial poisoning than others.'

"The other instance is the following:—A landowner had poisoned rats by means of corrosive sublimate, the rats chiefly infesting his stable. His coachman, a sober and robust young man, who used to sleep in the stable, became pale, lost his appetite and easily got tired. When on a visit at the gentleman's, the writer happened to see the servant, and when on his advice the boards were taken up the remains of 40 rats were found. The foundations were renewed, fresh sand being used for the purpose; all holes in the walls were closed with cement, and the servant was soon cured.' Here the corrosive sublimate was prevented to a certain extent from evaporating by the ammonia disengaged from the dung; the doors of the stable remained open during the warmer part of the day, and nevertheless the servant was poisoned by the mercurial vapour. These two cases ought to suffice to prove that mercuric chloride is a dangerous and malicious enemy."

Hager in his paper apparently traces these cases of poisoning principally to the small particles of solid mercuric chloride which may have been mechanically thrown off into the air, but, in view of the undoubted volatility of this salt in the solid state and even at ordinary atmospheric temperatures, it is much more probable that the poisoning was produced simply by the vapour of mercuric chloride. It might of course be argued that the amount of mercuric chloride vapour would be so small as to be unable to produce mercurial poisoning, but mercuric chloride is certainly as volatile as mercury is itself, and there is a case on record proving that mercury gives off sufficient vapour at the ordinary temperature of the air to cause salivation. This is described by Burnett.* He says, "A ship on the Spanish coast was carrying a cargo of mercury. Some of the mercury had escaped from the packages and got into the hold. All the exposed metal surfaces in the ship appear to have become coated with mercury in consequence, and the whole ship's company were effected with violent symptoms of salivation."

If therefore such cases of mercurial poisoning as are described by Hager, can take place from the use of mercuric chloride at European air temperatures, the very greatest care should be taken in a country like India where such violently poisonous substances as mercuric chloride are used in preserving books from the attacks of insects, as a vermin-

* Phils. Trans. 1823, P. 402.

killer, &c. and where such high air temperatures prevail. It is probably the fact that the custom in India of having almost all doors and windows constantly open has proved a safeguard against such poisoning in the case of libraries, etc., where mercuric chloride has been and is being used, but it does not appear to be desirable to rely on this fact, and it would be safer to discontinue altogether the use of such an insidious poison as mercuric chloride for the purposes above described.

X.—*Some Applications of Elliptic Functions to Problems of Mean Values.*
(First Paper).—By ASUTOSH MUKHOPADHYAY, M. A., F. R. A. S.,
F. R. S. E.

[Received July 25th;—Read August 1st, 1888.]

(With a Woodcut.)

CONTENTS.

- § 1. Expression for the area common to an ellipse and a concentric circle intersecting it.
- § 2. Mean value of the common area when the intersecting circle is of variable radius.
- § 3. Expression for the angle of intersection of the ellipse and the circle.
- § 4. Mean value of the angle of intersection.
- § 5. Mean value of the angle of intersection of the lines joining the opposite corners of the figure formed by the intersection of the ellipse and the circle.
- § 6. Mean value of the arc of the circle intercepted by the ellipse.

§ 1. *Expression for Common Area.*

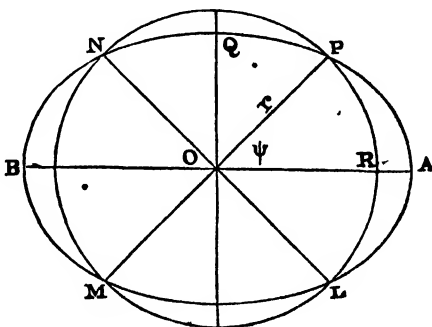
The object of the present paper is to discuss some problems of Mean Values which are chiefly interesting from the mode in which the application of Elliptic Functions simplifies the calculations.

In the first place, let us consider an ellipse and a concentric circle intersecting it; then, if the ellipse be NPA , and the circle NPR , the area of the portion common to both the curves may be found as follows, viz., the ellipse being

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

and the circle,

$$x^2 + y^2 = r^2,$$



the coordinates (α, β) of P, the point of intersection of the two curves, is easily found, viz.,

$$\alpha = a \left(\frac{r^2 - b^2}{a^2 - b^2} \right)^{\frac{1}{2}}$$

$$\beta = b \left(\frac{a^2 - r^2}{a^2 - b^2} \right)^{\frac{1}{2}}$$

Hence, if ψ be the angle which the central radius vector OP makes with OR, which is the axis of x , we have

$$\sin \psi = \frac{\beta}{r} = \frac{b}{r} \left(\frac{a^2 - r^2}{a^2 - b^2} \right)^{\frac{1}{2}}$$

$$\cos \psi = \frac{\alpha}{r} = \frac{a}{r} \left(\frac{r^2 - b^2}{a^2 - b^2} \right)^{\frac{1}{2}}$$

$$\tan \psi = \frac{\beta}{\alpha} = \frac{b}{a} \left(\frac{a^2 - r^2}{r^2 - b^2} \right)^{\frac{1}{2}}.$$

Now, the whole area common to the two curves is

$$4 \cdot \text{QORP} = 4 (\text{sector POR} + \text{sector POQ}).$$

But

$$\text{sector POR} = \frac{1}{2} r^2 \psi = \frac{r^2}{2} \sin^{-1} \left\{ \frac{b}{r} \left(\frac{a^2 - r^2}{a^2 - b^2} \right)^{\frac{1}{2}} \right\}.$$

Again, from the equation of the ellipse,

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1,$$

we have the polar equation

$$\rho^2 = \frac{a^2 b^2}{a^2 \sin^2 \theta + b^2 \cos^2 \theta},$$

so that

$$\begin{aligned} \text{sector POQ} &= \frac{1}{2} \int_{\psi}^{\frac{\pi}{2}} \rho^2 d\theta \\ &= \frac{1}{2} a^2 b^2 \int_{\psi}^{\frac{\pi}{2}} \frac{d\theta}{a^2 \sin^2 \theta + b^2 \cos^2 \theta} \\ &= \frac{1}{2} ab \left\{ \tan^{-1} \left(\frac{a}{b} \tan \theta \right) \right\}_{\theta=\psi}^{\theta=\frac{\pi}{2}} \\ &= \frac{\pi ab}{4} - \frac{ab}{2} \left\{ \tan^{-1} \left(\frac{a^2 - r^2}{r^2 - b^2} \right)^{\frac{1}{2}} \right\}. \end{aligned}$$

But it is easy to prove that

$$\tan^{-1} \left\{ \left(\frac{a^2 - r^2}{r^2 - b^2} \right)^{\frac{1}{2}} \right\} + \sin^{-1} \left\{ \left(\frac{r^2 - b^2}{a^2 - b^2} \right)^{\frac{1}{2}} \right\} = \frac{\pi}{2}.$$

Hence the

$$\text{sector POQ} = \frac{1}{2} ab \sin^{-1} \left\{ \left(\frac{r^2 - b^2}{a^2 - b^2} \right)^{\frac{1}{2}} \right\}.$$

Therefore, finally, the whole area common to the two curves is

$$= 2ab \sin^{-1} \left\{ \left(\frac{r^2 - b^2}{a^2 - b^2} \right)^{\frac{1}{2}} \right\} + 2r^2 \sin^{-1} \left\{ \frac{b}{r} \left(\frac{a^2 - r^2}{a^2 - b^2} \right)^{\frac{1}{2}} \right\}$$

For purposes of verification, we may note that, when $r = a$, this becomes πab , and when $r = b$, it reduces to πb^2 , as are geometrically evident.

§ 2. Mean value of the Common Area.

Let us now investigate the average area common to an ellipse and a concentric circle of variable radius which always intersects it. Let A be the common area when the radius of the circle is r ; then the required mean is given by

$$M = \frac{\int_b^a A \, dr}{\int_b^a dr},$$

whence

$$(a - b) M = \int_b^a A \, dr$$

But, from the formula proved in § 1, we have

$$A = 2ab \sin^{-1} \left\{ \left(\frac{r^2 - b^2}{a^2 - b^2} \right)^{\frac{1}{2}} \right\} + 2r^2 \sin^{-1} \left\{ \frac{b}{r} \left(\frac{a^2 - r^2}{a^2 - b^2} \right)^{\frac{1}{2}} \right\}$$

Hence,

$$\int_b^a A \, dr = 2ab P + 2Q,$$

where

$$P = \int_b^a \sin^{-1} \left\{ \left(\frac{r^2 - b^2}{a^2 - b^2} \right)^{\frac{1}{2}} \right\} dr$$

$$Q = \int_b^a r^2 \sin^{-1} \left\{ \frac{b}{r} \left(\frac{a^2 - r^2}{a^2 - b^2} \right)^{\frac{1}{2}} \right\} dr.$$

Consider now

$$P = \int_b^a \sin^{-1} \left\{ \left(\frac{r^2 - b^2}{a^2 - b^2} \right)^{\frac{1}{2}} \right\} dr.$$

Let

$$\frac{r^2 - b^2}{a^2 - b^2} = \sin^2 \xi,$$

so that, when

$$r = a, \quad \xi = \frac{\pi}{2},$$

$$r = b, \quad \xi = 0,$$

and

$$r^2 = a^2 \sin^2 \xi + b^2 \cos^2 \xi,$$

$$r dr = (a^2 - b^2) \sin \xi \cdot \cos \xi \cdot d\xi,$$

$$dr = (a^2 - b^2) \frac{\sin \xi \cdot \cos \xi \cdot d\xi}{(a^2 \sin^2 \xi + b^2 \cos^2 \xi)^{\frac{1}{2}}}.$$

Hence,

$$\begin{aligned} P &= (a^2 - b^2) \int_0^{\frac{\pi}{2}} \frac{\xi \cdot \sin \xi \cdot \cos \xi \cdot d\xi}{(a^2 \sin^2 \xi + b^2 \cos^2 \xi)^{\frac{1}{2}}} \\ &= \int_0^{\frac{\pi}{2}} \xi \cdot d \left\{ (a^2 \sin^2 \xi + b^2 \cos^2 \xi)^{\frac{1}{2}} \right\} \end{aligned}$$

Integrating by parts we have

$$\begin{aligned} P &= \left\{ \xi (a^2 \sin^2 \xi + b^2 \cos^2 \xi)^{\frac{1}{2}} \right\}_{\xi=0}^{\xi=\frac{\pi}{2}} \\ &\quad - \int_0^{\frac{\pi}{2}} (a^2 \sin^2 \xi + b^2 \cos^2 \xi)^{\frac{1}{2}} d\xi, \\ &= \frac{\pi a}{2} - \int_0^{\frac{\pi}{2}} (a^2 \sin^2 \xi + b^2 \cos^2 \xi)^{\frac{1}{2}} d\xi. \end{aligned}$$

Next consider

$$Q = \int_b^a r^2 \sin^{-1} \left\{ \frac{b}{r} \left(\frac{a^2 - r^2}{a^2 - b^2} \right)^{\frac{1}{2}} \right\} dr.$$

Let

$$\frac{b}{r} \left(\frac{a^2 - r^2}{a^2 - b^2} \right)^{\frac{1}{2}} = \sin \phi,$$

so that, when

$$r = a, \quad \phi = 0,$$

$$r = b, \quad \phi = \frac{\pi}{2},$$

and

$$\begin{aligned} r^2 &= \frac{a^2 b^2}{a^2 \sin^2 \phi + b^2 \cos^2 \phi} \\ r dr &= \frac{a^2 b^2 (b^2 - a^2) \sin \phi \cos \phi d\phi}{(a^2 \sin^2 \phi + b^2 \cos^2 \phi)^{\frac{3}{2}}} \\ dr &= \frac{ab (b^2 - a^2) \sin \phi \cos \phi d\phi}{(a^2 \sin^2 \phi + b^2 \cos^2 \phi)^{\frac{3}{2}}}. \end{aligned}$$

Hence,

$$\begin{aligned} Q &= a^3 b^3 (a^2 - b^2) \int_0^{\frac{\pi}{2}} \frac{\phi \sin \phi \cos \phi d\phi}{(a^2 \sin^2 \phi + b^2 \cos^2 \phi)^{\frac{5}{2}}} \\ &= -\frac{1}{3} a^3 b^3 \int_0^{\frac{\pi}{2}} \phi \cdot d \left\{ (a^2 \sin^2 \phi + b^2 \cos^2 \phi)^{-\frac{3}{2}} \right\} \end{aligned}$$

Integrating by parts, we get

$$\begin{aligned} Q &= -\frac{1}{3} a^3 b^3 \left\{ \frac{\phi}{(a^2 \sin^2 \phi + b^2 \cos^2 \phi)^{\frac{3}{2}}} \right\}_{\phi=0}^{\phi=\frac{\pi}{2}} \\ &\quad + \frac{1}{3} a^3 b^3 \int_0^{\frac{\pi}{2}} \frac{d\phi}{(a^2 \sin^2 \phi + b^2 \cos^2 \phi)^{\frac{3}{2}}} \\ &= \frac{1}{3} a^3 b^3 \int_0^{\frac{\pi}{2}} \frac{d\phi}{(a^2 \sin^2 \phi + b^2 \cos^2 \phi)^{\frac{3}{2}}} - \frac{\pi b^3}{6}. \end{aligned}$$

Therefore, we have

$$\begin{aligned} (a-b) M &= \pi a^2 b - \frac{\pi b^3}{3} \\ &\quad - 2ab \int_0^{\frac{\pi}{2}} (a^2 \sin^2 \xi + b^2 \cos^2 \xi)^{\frac{1}{2}} d\xi \end{aligned}$$

$$+ \frac{2}{3} a^3 b^3 \int_0^{\frac{\pi}{2}} \frac{d\phi}{(a^3 \sin^3 \phi + b^3 \cos^3 \phi)^{\frac{3}{2}}}.$$

To effect further reductions, we observe that generally

$$\int_0^{\frac{\pi}{2}} (a^3 \sin^3 \theta + b^3 \cos^3 \theta)^{\frac{1}{2}} d\theta = \int_0^{\frac{\pi}{2}} (a^3 \cos^3 \theta + b^3 \sin^3 \theta)^{\frac{1}{2}} d\theta,$$

for, putting

$$\theta = \frac{\pi}{2} - \theta',$$

so that, when

$$\theta = \frac{\pi}{2}, \quad \theta' = 0,$$

$$\theta = 0, \quad \theta' = \frac{\pi}{2},$$

$$d\theta = -d\theta',$$

we get, by substitution,

$$\begin{aligned} \int_0^{\frac{\pi}{2}} (a^3 \sin^3 \theta + b^3 \cos^3 \theta)^{\frac{1}{2}} d\theta &= \int_0^{\frac{\pi}{2}} (a^3 \cos^3 \theta' + b^3 \sin^3 \theta')^{\frac{1}{2}} d\theta', \\ &= \int_0^{\frac{\pi}{2}} (a^3 \cos^3 \theta + b^3 \sin^3 \theta)^{\frac{1}{2}} d\theta, \end{aligned}$$

as the variable is of no consequence in a definite integral. By a similar reasoning, we have

$$\int_0^{\frac{\pi}{2}} \frac{d\phi}{(a^3 \sin^3 \phi + b^3 \cos^3 \phi)^{\frac{3}{2}}} = \int_0^{\frac{\pi}{2}} \frac{d\phi}{(a^3 \cos^3 \phi + b^3 \sin^3 \phi)^{\frac{3}{2}}},$$

and in general

$$\int_0^{\frac{\pi}{2}} (a^3 \sin^3 \phi + b^3 \cos^3 \phi)^n d\phi = \int_0^{\frac{\pi}{2}} (a^3 \cos^3 \phi + b^3 \sin^3 \phi)^n d\phi,$$

which is a particular case of the more general formula

$$\int_0^{\frac{\pi}{2}} f(\sin x) dx = \int_0^{\frac{\pi}{2}} f(\cos x) dx.$$

Therefore, we have

$$\begin{aligned}
 (a-b)M &= \pi a^2 b - \frac{1}{3} \pi b^3 \\
 &+ \frac{2}{3} a^2 b^3 \int_0^{\frac{\pi}{2}} \frac{d\xi}{(a^2 \cos^2 \xi + b^2 \sin^2 \xi)^{\frac{3}{2}}} \\
 &- 2ab \int_0^{\frac{\pi}{2}} (a^2 \cos^2 \xi + b^2 \sin^2 \xi)^{\frac{1}{2}} d\xi.
 \end{aligned}$$

Now, we have*

$$\int_0^{\frac{\pi}{2}} \frac{d\xi}{(a^2 \cos^2 \xi + b^2 \sin^2 \xi)^{\frac{3}{2}}} = \frac{1}{a^3} \int_0^{\frac{\pi}{2}} \frac{d\xi}{(1 - e^2 \sin^2 \xi)^{\frac{3}{2}}},$$

where the eccentricity of the ellipse is given by

$$e^2 = \frac{a^2 - b^2}{a^2}.$$

But we have generally*

$$\begin{aligned}
 &\int_0^{\theta} \frac{d\theta}{(1 - e^2 \sin^2 \theta)^{\frac{3}{2}}} \\
 &= \frac{1}{1 - e^2} \left\{ \int_0^{\theta} (1 - e^2 \sin^2 \theta)^{\frac{1}{2}} d\theta - \frac{e^2 \sin \theta \cos \theta}{(1 - e^2 \sin^2 \theta)^{\frac{1}{2}}} \right\}.
 \end{aligned}$$

Therefore, we get

$$\begin{aligned}
 \int_0^{\frac{\pi}{2}} \frac{d\xi}{(a^2 \cos^2 \xi + b^2 \sin^2 \xi)^{\frac{3}{2}}} &= \frac{1}{a^3} \int_0^{\frac{\pi}{2}} \frac{d\xi}{(1 - e^2 \sin^2 \xi)^{\frac{3}{2}}} \\
 &= \frac{1}{a^3 (1 - e^2)} \int_0^{\frac{\pi}{2}} (1 - e^2 \sin^2 \xi)^{\frac{1}{2}} d\xi.
 \end{aligned}$$

We have also

$$\int_0^{\frac{\pi}{2}} (a^2 \cos^2 \xi + b^2 \sin^2 \xi)^{\frac{1}{2}} d\xi = a \int_0^{\frac{\pi}{2}} (1 - e^2 \sin^2 \xi)^{\frac{1}{2}} d\xi,$$

where, as before,

$$e^2 = \frac{a^2 - b^2}{a^2}.$$

Hence,

$$(a-b)M = \pi a^2 b - \frac{\pi}{3} b^3 + \frac{2}{3} \frac{b^3}{1 - e^2} \int_0^{\frac{\pi}{2}} (1 - e^2 \sin^2 \xi)^{\frac{1}{2}} d\xi$$

* See Dr. Schloemilch's *Théorie des Intégrales et des Fonctions Elliptiques*, par Dr. Graindorge, (1873), p 14.

$$\begin{aligned}
 & -2a^2b \int_0^{\frac{\pi}{2}} (1 - e^2 \sin^2 \xi)^{\frac{1}{2}} d\xi \\
 & = \pi a^2b - \frac{1}{3} \pi b^3 - \frac{4}{3} a^2b E_1
 \end{aligned}$$

where

$$E_1 = \int_0^{\frac{\pi}{2}} (1 - e^2 \sin^2 \xi)^{\frac{1}{2}} d\xi$$

so that E_1 is the complete elliptic integral of the second kind with the eccentricity for modulus. Therefore,

$$M = \frac{1}{3} \frac{b}{a-b} \left\{ \pi (3a^2 - b^2) - 4a^2 E_1 \right\}.$$

If l be the perimeter of the ellipse, we have

$$l = 4a \int_0^{\frac{\pi}{2}} (1 - e^2 \sin^2 \xi)^{\frac{1}{2}} d\xi = 4a E_1.$$

Hence, finally, we have the

THEOREM. The average area common to an ellipse and a concentric circle of variable radius which always intersects it is

$$\frac{1}{3} \frac{b}{a-b} \left\{ \pi (3a^2 - b^2) - al \right\},$$

where a , b are the semiaxes, and l the perimeter of the ellipse.

§ 3 *Expression for Angle of Intersection.*

If ω be the angle of intersection of the ellipse and the circle, its value may be easily calculated as follows. The coordinates of the point of intersection P being α , β , we have

$$\begin{aligned}
 \alpha &= \frac{a}{\sqrt{a^2 - b^2}} \sqrt{r^2 - b^2}, \\
 \beta &= \frac{b}{\sqrt{a^2 - b^2}} \sqrt{a^2 - r^2}
 \end{aligned}$$

The tangent to the circle at P is

$$ax + \beta y = r^2,$$

and the tangent to the ellipse is

$$\frac{ax}{a^2} + \frac{\beta y}{b^2} = 1,$$

whence we have

$$\begin{aligned}
 \tan \omega &= \frac{-\frac{b^2}{a^2} \frac{a}{\beta} + \frac{a}{\beta}}{1 + \frac{b^2}{a^2} \frac{a^2}{\beta^2}} \\
 &= \frac{a^2 - b^2}{a^2} \cdot \frac{a}{\beta} \cdot \frac{a^2 \beta^2}{a^2 \beta^2 + b^2 a^2} \\
 &= \frac{1}{ab} \left\{ (a^2 - r^2)(r^2 - b^2) \right\}^{\frac{1}{2}}.
 \end{aligned}$$

Hence,

$$ab \tan \omega = \sqrt{(a^2 - r^2)(r^2 - b^2)}.$$

§ 4. Mean Value of Angle of Intersection.

Let us now find the mean value of the angle of intersection of an ellipse and a concentric circle of variable radius which always intersects it. Let ω be the angle of intersection when the radius of the intersecting circle is r ; then, if Ω be the mean value required, we have

$$\Omega = \frac{\int_b^a \omega \, dr}{\int_b^a dr},$$

whence

$$(a - b) \Omega = \int_b^a \omega \, dr.$$

Integrating by parts, we have

$$(a - b) \Omega = \left[r\omega \right]_{r=b}^{r=a} - \int_{r=b}^{r=a} r \, d\omega.$$

Now, from § 3, we have

$$ab \tan \omega = \left\{ (a^2 - r^2)(r^2 - b^2) \right\}^{\frac{1}{2}}$$

which shews that, when

$$\begin{aligned}
 r &= a, & \omega &= 0, \\
 r &= b, & \omega &= 0,
 \end{aligned}$$

so that the integrated part vanishes at both limits. We also easily calculate by logarithmic differentiation that

$$\frac{d\omega}{dr} = \frac{ab(a^2 + b^2 - 2r^2)}{r(a^2 + b^2 - r^2)^{\frac{1}{2}}(r^2 - b^2)^{\frac{1}{2}}}.$$

Substituting, therefore, in the equation

$$(a-b)\Omega = \left[r\omega \right]_{r=b}^{r=a} - \int_{r=b}^{r=a} r d\omega,$$

we have

$$(a-b)\Omega = -ab \int_b^a \frac{a^2 + b^2 - 2r^2}{(a^2 + b^2 - r^2)(a^2 - r^2)^{\frac{1}{2}}(r^2 - b^2)^{\frac{1}{2}}} dr.$$

Assume

$$(a^2 - r^2) = (r^2 - b^2) \tan^2 \theta,$$

so that, when

$$r = a, \quad \theta = 0$$

$$r = b, \quad \theta = \frac{\pi}{2},$$

and we have also the relations

$$a^2 + b^2 - 2r^2 = (b^2 - a^2) \cos 2\theta,$$

$$a^2 + b^2 - r^2 = a^2 \sin^2 \theta + b^2 \cos^2 \theta,$$

$$a^2 - r^2 = (a^2 - b^2) \sin^2 \theta,$$

$$r^2 - b^2 = (a^2 - b^2) \cos^2 \theta,$$

$$dr = \frac{(b^2 - a^2) \sin \theta \cos \theta}{(a^2 \cos^2 \theta + b^2 \sin^2 \theta)^{\frac{1}{2}}} d\theta.$$

Making these substitutions, we have

$$(a-b)\Omega = \int_0^{\frac{\pi}{2}} \frac{ab(a^2 - b^2) \cos 2\theta d\theta}{(a^2 \cos^2 \theta + b^2 \sin^2 \theta)^{\frac{1}{2}}(a^2 \sin^2 \theta + b^2 \cos^2 \theta)},$$

or

$$\begin{aligned} \frac{\Omega}{ab(a+b)} &= \int_0^{\frac{\pi}{2}} \frac{(1 - 2 \sin^2 \theta) d\theta}{(a^2 \sin^2 \theta + b^2 \cos^2 \theta)(a^2 \cos^2 \theta + b^2 \sin^2 \theta)^{\frac{1}{2}}} \\ &= \int_0^{\frac{\pi}{2}} \frac{d\theta}{(a^2 \sin^2 \theta + b^2 \cos^2 \theta)(a^2 \cos^2 \theta + b^2 \sin^2 \theta)^{\frac{1}{2}}} \\ &\quad - 2 \int_0^{\frac{\pi}{2}} \frac{\sin^2 \theta d\theta}{(a^2 \sin^2 \theta + b^2 \cos^2 \theta)(a^2 \cos^2 \theta + b^2 \sin^2 \theta)^{\frac{1}{2}}}. \end{aligned}$$

Putting

$$\cos^2 \theta = 1 - \sin^2 \theta, \quad n = \frac{a^2 - b^2}{b^2}, \quad k^2 = \frac{a^2 - b^2}{a^2},$$

we get

$$\begin{aligned} \frac{b}{a+b} \Omega &= \int_0^{\frac{\pi}{2}} \frac{d\theta}{(1+n\sin^2\theta)(1-k^2\sin^2\theta)^{\frac{1}{2}}} \\ &- 2 \int_0^{\frac{\pi}{2}} \frac{\sin^2\theta d\theta}{(1+n\sin^2\theta)(1-k^2\sin^2\theta)^{\frac{1}{2}}} \\ &= P - 2R. \end{aligned}$$

But, from a known formula (*), we have

$$R = \frac{1}{n} (F - P)$$

Therefore,

$$\frac{\Omega b}{a+b} = P + \frac{2}{n} (P - F) = \left(1 + \frac{2}{n}\right) P - \frac{2}{n} F = \frac{a^2 + b^2}{a^2 - b^2} P - \frac{2b^2}{a^2 - b^2} F.$$

This shews that the average value of the angle of intersection of the two curves may be expressed in terms of two complete elliptic integrals of the first and third kind. It is interesting to note that the result depends simply on the ratio of the axes of the ellipse, viz., if $b = a\lambda$, we have

$$(1 - \lambda) \Omega = \left(\lambda + \frac{1}{\lambda}\right) P - 2\lambda F.$$

Hence we may enunciate the

THEOREM. The average value of the angle of intersection of an ellipse and a concentric circle of variable radius which always intersects it is

$$\frac{1 + \lambda^2}{\lambda(1 - \lambda)} P - \frac{2\lambda}{1 - \lambda} F$$

where λ is the ratio of the axes $\left(= \frac{b}{a}\right)$, and F, P denote complete elliptic integrals of the first and third kind respectively, the modulus being $(1 - \lambda^2)$ and the parameter $\frac{1 - \lambda^2}{\lambda^2}$.

§ 5. Mean Value of another angle.

If we join the opposite corners of the curvilinear area formed by the intersection of the circle and the ellipse, the joining lines will evidently intersect in the common centre of the two curves; we shall now proceed to investigate the average value of the acute angle included by these two diameters.

* See Dr. Schloemilch's *Théorie des Intégrales et des Fonctions Elliptiques*, par Dr. Graindorge, (1873), p. 63; Cayley's *Elliptic Functions*, p. 15, § 33.

Since the angle $\text{POR} = \psi$, we have to find the average value of 2ψ . If, therefore, Γ be the average value required, we have

$$\Gamma = \frac{\int_b^a 2\psi \cdot dr}{\int_b^a dr},$$

whence

$$\frac{1}{2} (a-b) \Gamma = \int_b^a \psi \cdot dr.$$

Integrating by parts, we have

$$\frac{1}{2} (a-b) \Gamma = \left[r \psi \right]_{r=b}^{r=a} - \int_{r=b}^{r=a} r \cdot d\psi.$$

But, from the formulas in § 1, we have

$$\tan \psi = \frac{\beta}{a} = \frac{b}{a} \left(\frac{a^2 - r^2}{r^2 - b^2} \right)^{\frac{1}{2}},$$

so that, when

$$r = a, \quad \psi = 0$$

$$r = b, \quad \psi = \frac{\pi}{2}.$$

Therefore,

$$\frac{1}{2} (a-b) \Gamma = -\frac{\pi b}{2} - \int_{r=b}^{r=a} r \cdot d\psi.$$

Assume

$$r^2 = a^2 \cos^2 \eta + b^2 \sin^2 \eta$$

so that

$$a^2 - r^2 = (a^2 - b^2) \sin^2 \eta,$$

$$r^2 - b^2 = (a^2 - b^2) \cos^2 \eta,$$

and, accordingly,

$$\tan \psi = \frac{b}{a} \tan \eta$$

$$\sec^2 \psi \cdot d\psi = \frac{b}{a} \sec^2 \eta \cdot d\eta$$

$$d\psi = \frac{ab}{a^2 \cos^2 \eta + b^2 \sin^2 \eta} d\eta$$

$$r \cdot d\psi = \frac{ab}{(a^2 \cos^2 \eta + b^2 \sin^2 \eta)^{\frac{1}{2}}} d\eta.$$

Therefore

$$r d\psi = \frac{b}{(1 - e^2 \sin^2 \eta)^{\frac{1}{2}}} d\eta.$$

We have also, when

$$\begin{aligned} r &= a, & \eta &= 0 \\ r &= b, & \eta &= \frac{\pi}{2}. \end{aligned}$$

Therefore, finally,

$$\begin{aligned} \frac{1}{2} (a - b) \Gamma &= -\frac{\pi b}{2} + b \int_0^{\frac{\pi}{2}} \frac{d\eta}{(1 - e^2 \sin^2 \eta)^{\frac{1}{2}}} \\ &= b \left(F - \frac{\pi}{2} \right), \end{aligned}$$

and

$$\Gamma = \frac{b}{a - b} (2F - \pi),$$

which shows that the average value of the angle between the diameters can be expressed in terms of a complete elliptic integral of the first kind with the eccentricity for modulus. If l be the perimeter of the ellipse, since we have

$$l = 4a \int_0^{\frac{\pi}{2}} (1 - e^2 \sin^2 \eta)^{\frac{1}{2}} d\eta$$

and

$$\frac{1}{4} \frac{d}{de} \left(\frac{l}{a} \right) = -e \int_0^{\frac{\pi}{2}} \frac{d\eta}{(1 - e^2 \sin^2 \eta)^{\frac{1}{2}}} = -e F,$$

we may enunciate the

THEOREM. The average value of the acute angle of intersection of the diameters of the curvilinear quadrilateral formed by the intersection of an ellipse and a concentric circle of variable radius is

$$\frac{b}{b - a} \left\{ \pi + \frac{1}{2e} \frac{d}{de} \left(\frac{l}{a} \right) \right\}$$

where a, b are the semi-axes, e the eccentricity, and l the perimeter of the ellipse.

§ 6. Mean Value of Intercepted Circular Arc.

We shall now investigate the average value of the two circular arcs PL and MN intercepted by the ellipse. Since, $PR = r\psi$, we have

to find the mean value of $4r\psi$; so that, if σ be the average value required, we have

$$\sigma = \frac{\int_b^a 4r\psi \cdot dr}{\int_b^a dr},$$

whence

$$(a-b)\sigma = 4 \int_b^a r\psi dr.$$

Now, from the formulas proved in § 1, we have

$$\sin \psi = \frac{b}{r} \left(\frac{a^2 - r^2}{a^2 - b^2} \right)^{\frac{1}{2}}.$$

Therefore,

$$(a-b)\sigma = 4 \int_b^a r \sin^{-1} \left\{ \frac{b}{r} \left(\frac{a^2 - r^2}{a^2 - b^2} \right)^{\frac{1}{2}} \right\} dr$$

Assume

$$\frac{b}{r} \left(\frac{a^2 - r^2}{a^2 - b^2} \right)^{\frac{1}{2}} = \sin \phi,$$

so that, when

$$r = a, \quad \phi = 0,$$

$$r = b, \quad \phi = \frac{\pi}{2},$$

and we have

$$r^2 = \frac{a^2 b^2}{a^2 \sin^2 \phi + b^2 \cos^2 \phi}$$

$$r dr = \frac{a^2 b^2 (b^2 - a^2) \sin \phi \cos \phi d\phi}{(a^2 \sin^2 \phi + b^2 \cos^2 \phi)^2}.$$

Hence, by substitution,

$$(a-b)\sigma = 4 \int_0^{\frac{\pi}{2}} \frac{a^2 b^2 (a^2 - b^2) \phi \sin \phi \cos \phi d\phi}{(a^2 \sin^2 \phi + b^2 \cos^2 \phi)^2}$$

$$= -2a^2 b^2 \int_0^{\frac{\pi}{2}} \phi d \left\{ (a^2 \sin^2 \phi + b^2 \cos^2 \phi)^{-1} \right\}$$

Integrating by parts, we have

$$\begin{aligned}
 (a-b)\sigma &= -2a^2b^2 \left[\frac{\phi}{a^2 \sin^2 \phi + b^2 \cos^2 \phi} \right]_{\phi=0}^{\phi=\frac{\pi}{2}} \\
 &+ 2a^2b^2 \int_0^{\frac{\pi}{2}} \frac{d\phi}{a^2 \sin^2 \phi + b^2 \cos^2 \phi} \\
 &= \pi b (a-b).
 \end{aligned}$$

Therefore,

$$\sigma = \pi b.$$

Hence we have the

THEOREM. If an ellipse is intersected by a concentric circle of variable radius, the average value of the circular arc intercepted is πb .

25th July, 1888.

XI.—*Some Applications of Elliptic Functions to Problems of Mean Values.*
(Second Paper).—By ASUTOSH MUKHOPADHYAY, M. A., F. R. A. S.,
F. R. S. E.

[Received October 22nd ;—Read November 7th, 1888.]

CONTENTS.

§ 1. Introduction.

§§ 2—5. First case.

(§ 2). Expression for common volume.

(§ 3) Expression for the mean value.

(§ 4). Geometric interpretation.

(§ 5). Canonical form for volume.

§ 6. Second case.

§ 1. Introduction.

In my first paper on “Some Applications of Elliptic Functions to Problems of Mean Values,” which was read before the Society in August last,* I discussed, among other questions, the problem of determining the average area common to an ellipse and a concentric circle of variable radius always intersecting it; the present paper is devoted to a discussion of the corresponding space-analogue. Given the ellipsoid,

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1, \quad (1)$$

* See above, pp. 199—213; P. A. S. B. (1888), pp. 184—5. For a full analysis of the present paper, see P. A. S. B. (1888), pp. 207—8.

we have to determine the average value of the volume common to this ellipsoid and the concentric sphere

$$x^2 + y^2 + z^2 = r^2 \quad (2)$$

which always intersects it. We have obviously two distinct cases, according as *four* or *two* vertices of the ellipsoid are exterior to the sphere: in the first case, we have

$$a > b > r > c,$$

and in the second case

$$a > r > b > c,$$

so that the limits of r are, in the two cases,

$$\left. \begin{array}{l} r=b \\ r=c \end{array} \right\} \quad \left. \begin{array}{l} r=a \\ r=b \end{array} \right\}$$

respectively. In the following investigation, we shall consider the two cases separately.

§§ 2—6. *First Case.*

§ 2. *Expression for the Common Volume.*

Suppose four vertices of the ellipsoid to be exterior to the sphere, and let V be the portion of the common volume lying in the positive octant; then if ν be the portion of the sphere outside the ellipsoid in the same octant, we have

$$V = \frac{1}{8}\pi r^3 - \nu \quad (3).$$

If z' , z'' be the ordinates of the spherical and the ellipsoidal surface respectively, corresponding to the same system of values of x and y , we have

$$\nu = \iint (z' - z'') \, dx \, dy,$$

where

$$\begin{aligned} z'^2 &= r^2 - x^2 - y^2 \\ \frac{z''^2}{c^2} &= 1 - \frac{x^2}{a^2} - \frac{y^2}{b^2} \end{aligned}$$

Hence

$$\nu = \iint \left\{ (r^2 - x^2 - y^2)^{\frac{1}{2}} - c \left(1 - \frac{x^2}{a^2} - \frac{y^2}{b^2} \right)^{\frac{1}{2}} \right\} dx \, dy \quad (4)$$

Eliminating z between (1) and (2), we have for the equation of the curve of projection on the coordinate plane of xy

$$\left(1 - \frac{c^2}{a^2} \right) x^2 + \left(1 - \frac{c^2}{b^2} \right) y^2 = r^2 - c^2 \quad (5).$$

For integrating $z' \, dx \, dy$, put

$$x = \rho \cos \omega, \quad y = \rho \sin \omega,$$

which gives

$$z' dx dy = \sqrt{r^2 - \rho^2} \rho d\rho d\omega,$$

and, by the same substitution, (5) is transformed into

$$\rho' = ab \sqrt{\left\{ \frac{r^2 - c^2}{a^2 b^2 - c^2 (b^2 \cos^2 \omega + a^2 \sin^2 \omega)} \right\}} \quad (6)$$

Similarly, to integrate $z'' dx dy$, put

$$\frac{x}{a} = \rho \cos \omega, \quad \frac{y}{b} = \rho \sin \omega,$$

which gives

$$z'' dx dy = abc \sqrt{1 - \rho^2} \rho d\rho d\omega,$$

and the same substitution transforms (5) into

$$\rho'' = \sqrt{\left\{ \frac{r^2 - c^2}{a^2 \cos^2 \omega + b^2 \sin^2 \omega - c^2} \right\}} \quad (7)$$

By these two substitutions, the formula (4) becomes

$$\begin{aligned} v = & \int \int \sqrt{r^2 - \rho^2} \rho d\rho d\omega \\ & - abc \int \int \sqrt{1 - \rho^2} \rho d\rho d\omega. \end{aligned} \quad (8)$$

In the first double integral, the limits are

$$\left. \begin{array}{l} \rho = 0 \\ \rho = \rho' \end{array} \right\} \quad \left. \begin{array}{l} \omega = 0 \\ \omega = \frac{\pi}{2} \end{array} \right\}$$

and in the second

$$\left. \begin{array}{l} \rho = 0 \\ \rho = \rho'' \end{array} \right\} \quad \left. \begin{array}{l} \omega = 0 \\ \omega = \frac{\pi}{2} \end{array} \right\}$$

We obtain immediately

$$\begin{aligned} & \int_0^{\rho'} \sqrt{r^2 - \rho^2} \rho d\rho = \frac{r^3}{3} - \frac{c^3}{3} \left\{ \frac{a^2 b^2 - r^2 (b^2 \cos^2 \omega + a^2 \sin^2 \omega)}{a^2 b^2 - c^2 (b^2 \cos^2 \omega + a^2 \sin^2 \omega)} \right\}^{\frac{3}{2}} \\ & \int_0^{\rho''} \sqrt{1 - \rho^2} \rho d\rho = \frac{1}{3} - \frac{1}{3} \left\{ \frac{a^2 \cos^2 \omega + b^2 \sin^2 \omega - r^2}{a^2 \cos^2 \omega + b^2 \sin^2 \omega - c^2} \right\}^{\frac{3}{2}} \end{aligned}$$

The formula (8) reduces to

$$v = \frac{\pi}{6} (r^3 - abc) - \frac{1}{3} c^3 A + \frac{1}{3} abc B$$

where the values of A and B are given by

$$A = \int_0^{\frac{\pi}{2}} \left\{ \frac{a^2 b^2 - r^2 (b^2 \cos^2 \omega + a^2 \sin^2 \omega)}{a^2 b^2 - c^2 (b^2 \cos^2 \omega + a^2 \sin^2 \omega)} \right\}^{\frac{3}{2}} d\omega \quad (10)$$

$$B = \int_0^{\frac{\pi}{2}} \left\{ \frac{a^2 \cos^2 \omega + b^2 \sin^2 \omega - r^2}{a^2 \cos^2 \omega + b^2 \sin^2 \omega - c^2} \right\}^{\frac{3}{2}} d\omega \quad (11)$$

Therefore, finally, from (3) we get

$$V = \frac{\pi}{6} abc + \frac{1}{3} c^3 A - \frac{1}{3} abc B \quad (12)$$

§ 3. *Expression for the Mean Value.*

We now proceed to calculate the mean value of the volume common to the sphere and the ellipsoid. If M be the average value sought, we have

$$\frac{M}{8} = \frac{\int_c^b V dr}{\int_c^b dr},$$

which gives

$$\begin{aligned} \frac{b-c}{8} M &= \int_c^b V dr \\ &= \frac{1}{6} \pi abc \int_c^b dr + \frac{1}{3} c^3 \int_c^b A dr - \frac{1}{3} abc \int_c^b B dr, \end{aligned}$$

whence

$$\frac{3(b-c)}{c} \left\{ \frac{M}{8} - \frac{\pi abc}{6} \right\} = c^2 \int_c^b A dr - ab \int_c^b B dr. \quad (13)$$

To calculate

$$\int_c^b A dr,$$

substitute in (10)

$$\lambda^2 = \frac{a^2 b^2}{b^2 \cos^2 \omega + a^2 \sin^2 \omega},$$

so that

$$\begin{aligned} \lambda d\lambda &= -a^2 b^2 (a^2 - b^2) \frac{\sin \omega \cos \omega d\omega}{(b^2 \cos^2 \omega + a^2 \sin^2 \omega)^2}, \\ \cos^2 \omega &= \frac{a^2}{\lambda^2} \cdot \frac{\lambda^2 - b^2}{a^2 - b^2}, \quad \sin^2 \omega = \frac{b^2}{\lambda^2} \cdot \frac{a^2 - \lambda^2}{a^2 - b^2}, \\ d\omega &= -ab \frac{d\lambda}{\lambda(a^2 - \lambda^2)^{\frac{1}{2}}(\lambda^2 - b^2)^{\frac{1}{2}}}. \end{aligned}$$

and for

$$\begin{aligned}\omega &= \frac{\pi}{2}, & \lambda &= b \\ \omega &= 0, & \lambda &= a.\end{aligned}$$

Therefore

$$A = ab \int_b^a \left(\frac{\lambda^2 - r^2}{\lambda^2 - c^2} \right)^{\frac{3}{2}} \frac{d\lambda}{\lambda (a^2 - \lambda^2)^{\frac{1}{2}} (\lambda^2 - b^2)^{\frac{1}{2}} (\lambda^2 - c^2)^{\frac{1}{2}}}.$$

Hence, since λ is independent of r , we have

$$\int_c^b A dr = ab \int_b^a \frac{d\lambda}{\lambda (a^2 - \lambda^2)^{\frac{1}{2}} (\lambda^2 - b^2)^{\frac{1}{2}} (\lambda^2 - c^2)^{\frac{3}{2}}} \int_c^b (\lambda^2 - r^2)^{\frac{3}{2}} dr.$$

Substituting

$$\begin{aligned}r &= \lambda \sin \phi \\ dr &= \lambda \cos \phi d\phi,\end{aligned}$$

we get

$$\int_c^b A dr = ab \int_b^a \frac{\lambda^3 d\lambda}{(a^2 - \lambda^2)^{\frac{1}{2}} (\lambda^2 - b^2)^{\frac{1}{2}} (\lambda^2 - c^2)^{\frac{3}{2}}} \int_{\sin^{-1} \frac{c}{\lambda}}^{\sin^{-1} \frac{b}{\lambda}} \cos^4 \phi d\phi.$$

But

$$\int \cos^4 \phi d\phi = \frac{1}{8} \sin \phi \cos \phi - \frac{1}{4} \sin^3 \phi \cos \phi + \frac{3}{8} \phi.$$

Hence, finally,

$$\int_c^b A dr = ab \int_b^a \frac{f(\lambda) \lambda^3 d\lambda}{(a^2 - \lambda^2)^{\frac{1}{2}} (\lambda^2 - b^2)^{\frac{1}{2}} (\lambda^2 - c^2)^{\frac{3}{2}}} \quad (14)$$

where

$$\begin{aligned}f(\lambda) &= \frac{5b}{8\lambda} \sqrt{1 - \frac{b^2}{\lambda^2}} - \frac{5c}{8\lambda} \sqrt{1 - \frac{c^2}{\lambda^2}} \\ &\quad - \frac{1}{4} \frac{b^3}{\lambda^3} \sqrt{1 - \frac{b^2}{\lambda^2}} + \frac{1}{4} \frac{c^3}{\lambda^3} \sqrt{1 - \frac{c^2}{\lambda^2}} \\ &\quad + \frac{3}{8} \sin^{-1} \frac{b}{\lambda} - \frac{3}{8} \sin^{-1} \frac{c}{\lambda}.\end{aligned} \quad (15)$$

To calculate

$$\int_c^b B dr,$$

substitute in (11)

$$\mu^2 = a^2 \cos^2 \omega + b^2 \sin^2 \omega,$$

so that

$$\begin{aligned}\mu d\mu &= -(a^2 - b^2) \sin \omega \cos \omega d\omega \\ \cos^2 \omega &= \frac{\mu^2 - b^2}{a^2 - b^2}, \quad \sin^2 \omega = \frac{a^2 - \mu^2}{a^2 - b^2}, \\ d\omega &= -\frac{\mu d\mu}{(a^2 - \mu^2)^{\frac{1}{2}} (\mu^2 - b^2)^{\frac{1}{2}}},\end{aligned}$$

and for

$$\begin{aligned}\omega &= \frac{\pi}{2}, & \mu &= b, \\ \omega &= 0, & \mu &= a.\end{aligned}$$

Therefore

$$B = \int_b^a \left(\frac{\mu^2 - r^2}{\mu^2 - c^2} \right)^{\frac{3}{2}} \frac{\mu d\mu}{(a^2 - \mu^2)^{\frac{1}{2}} (\mu^2 - b^2)^{\frac{1}{2}}}.$$

Hence, since μ is independent of r , we have

$$\int_c^b B dr = \int_b^a \frac{\mu d\mu}{(a^2 - \mu^2)^{\frac{1}{2}} (\mu^2 - b^2)^{\frac{1}{2}} (\mu^2 - c^2)^{\frac{3}{2}}} \int_c^b (\mu^2 - r^2)^{\frac{3}{2}} dr.$$

Substituting

$$\begin{aligned}r &= \mu \sin \phi \\ dr &= \mu \cos \phi d\phi,\end{aligned}$$

we have

$$\int_c^b B dr = \int_b^a \frac{\mu^5 d\mu}{(a^2 - \mu^2)^{\frac{1}{2}} (\mu^2 - b^2)^{\frac{1}{2}} (\mu^2 - c^2)^{\frac{3}{2}}} \int_{\sin^{-1} \frac{c}{\mu}}^{\sin^{-1} \frac{b}{\mu}} \cos^4 \phi d\phi,$$

or putting

$$\int_{\sin^{-1} \frac{c}{\mu}}^{\sin^{-1} \frac{b}{\mu}} \cos^4 \phi d\phi = f(\mu),$$

we have

$$\int_c^b B dr = \int_b^a \frac{f(\mu) \mu^5 d\mu}{(a^2 - \mu^2)^{\frac{1}{2}} (\mu^2 - b^2)^{\frac{1}{2}} (\mu^2 - c^2)^{\frac{3}{2}}},$$

or, since the variable is of no consequence in a definite integral, we get

$$\int_c^b B dr = \int_b^a \frac{f(\lambda) \lambda^5 d\lambda}{(a^2 - \lambda^2)^{\frac{1}{2}} (\lambda^2 - b^2)^{\frac{1}{2}} (\lambda^2 - c^2)^{\frac{3}{2}}}. \quad (16)$$

Substituting from (14) and (16) in (13), we have

$$\begin{aligned} \frac{3(b-c)}{c} \left\{ \frac{M}{8} - \frac{\pi abc}{6} \right\} &= c^3 \int_c^b A \, dr - ab \int_c^b B \, dr \\ &= -ab \int_b^a \frac{f(\lambda) \cdot \lambda^3 (\lambda^2 - c^2) \, d\lambda}{(a^2 - \lambda^2)^{\frac{1}{2}} (\lambda^2 - b^2)^{\frac{1}{2}} (\lambda^2 - c^2)^{\frac{1}{2}}} \\ &= ab \int_a^b \frac{f(\lambda) \lambda^3 \, d\lambda}{(a^2 - \lambda^2)^{\frac{1}{2}} (\lambda^2 - b^2)^{\frac{1}{2}} (\lambda^2 - c^2)^{\frac{1}{2}}}. \end{aligned}$$

Therefore, finally,

$$\frac{3(b-c)}{abc} \left\{ \frac{M}{8} - \frac{\pi abc}{6} \right\} = \int_a^b \frac{f(\lambda) \lambda^3 \, d\lambda}{(a^2 - \lambda^2)^{\frac{1}{2}} (\lambda^2 - b^2)^{\frac{1}{2}} (\lambda^2 - c^2)^{\frac{1}{2}}} \quad (17)$$

where $f(\lambda)$ has the value defined in equation (5); this equation gives the required mean value.

To evaluate this definite integral, we notice that there are six terms in $f(\lambda)$, say

$$f(\lambda) = P_1 + P_2 + Q_1 + Q_2 + R_1 + R_2,$$

where

$$P_1 = \frac{5b}{8} \frac{(\lambda^2 - b^2)^{\frac{1}{2}}}{\lambda^2}$$

$$P_2 = -\frac{5c}{8} \frac{(\lambda^2 - c^2)^{\frac{1}{2}}}{\lambda^2}$$

$$Q_1 = -\frac{b^3}{4} \frac{(\lambda^2 - b^2)^{\frac{1}{2}}}{\lambda^4}$$

$$Q_2 = \frac{c^3}{4} \frac{(\lambda^2 - c^2)^{\frac{1}{2}}}{\lambda^4}$$

$$R_1 = \frac{3}{8} \sin^{-1} \frac{b}{\lambda}$$

$$R_2 = -\frac{3}{8} \sin^{-1} \frac{c}{\lambda}.$$

Now,

$$\begin{aligned} &\int_a^b \frac{P_1 \lambda^3 \, d\lambda}{(a^2 - \lambda^2)^{\frac{1}{2}} (\lambda^2 - b^2)^{\frac{1}{2}} (\lambda^2 - c^2)^{\frac{1}{2}}} \\ &= \frac{5b}{8} \int_a^b \frac{\lambda \, d\lambda}{(a^2 - \lambda^2)^{\frac{1}{2}} (\lambda^2 - c^2)^{\frac{1}{2}}}, \\ &= \frac{5b}{16} \int_{a^2}^{b^2} \frac{du}{(a^2 - u)^{\frac{1}{2}} (u - c^2)^{\frac{1}{2}}}, \end{aligned} \quad [u = \lambda^2.]$$

$$\begin{aligned}
&= \frac{5b}{8} \left[\sin^{-1} \left(\frac{u-c^2}{a^2-c^2} \right)^{\frac{1}{2}} \right]_{u=a^2}^{u=b^2} \\
&= \frac{5b}{8} \left[\sin^{-1} \left(\frac{b^2-c^2}{a^2-c^2} \right)^{\frac{1}{2}} - \frac{\pi}{2} \right] \\
&= -\frac{5b}{8} \cos^{-1} \left(\frac{b^2-c^2}{a^2-c^2} \right)^{\frac{1}{2}}. \tag{18}
\end{aligned}$$

Again,

$$\begin{aligned}
&\int_a^b \frac{P_2 \lambda^3 d\lambda}{(a^2-\lambda^2)^{\frac{1}{2}}(\lambda^2-b^2)^{\frac{1}{2}}(\lambda^2-c^2)^{\frac{1}{2}}} \\
&= -\frac{5c}{8} \int_a^b \frac{\lambda d\lambda}{(a^2-\lambda^2)^{\frac{1}{2}}(\lambda^2-b^2)^{\frac{1}{2}}}, \\
&= -\frac{5c}{16} \int_{a^2}^{b^2} \frac{du}{(a^2-u)^{\frac{1}{2}}(u-b^2)^{\frac{1}{2}}}, \quad [u=\lambda^2. \\
&= -\frac{5c}{8} \left[\sin^{-1} \left(\frac{u-b^2}{a^2-b^2} \right)^{\frac{1}{2}} \right]_{u=a^2}^{u=b^2} \\
&= \frac{5\pi c}{16}. \tag{19}
\end{aligned}$$

Again,

$$\begin{aligned}
&\int_a^b \frac{Q_1 \lambda^3 d\lambda}{(a^2-\lambda^2)^{\frac{1}{2}}(\lambda^2-b^2)^{\frac{1}{2}}(\lambda^2-c^2)^{\frac{1}{2}}} \\
&= -\frac{b^3}{4} \int_a^b \frac{d\lambda}{\lambda(a^2-\lambda^2)^{\frac{1}{2}}(\lambda^2-c^2)^{\frac{1}{2}}}, \\
&= \frac{b^3}{8} \int_{\frac{1}{a^2}}^{\frac{1}{b^2}} \frac{dv}{(a^2v-1)^{\frac{1}{2}}(1-c^2v)^{\frac{1}{2}}} \quad \left[v = \frac{1}{\lambda^2} \right] \\
&= \frac{b^3}{4ac} \left[\sin^{-1} \left\{ \frac{c^2(a^2v-1)}{a^2-c^2} \right\}^{\frac{1}{2}} \right]_{v=\frac{1}{a^2}}^{v=\frac{1}{b^2}} \\
&= \frac{b^3}{4ac} \sin^{-1} \frac{c}{b} \left(\frac{a^2-b^2}{a^2-c^2} \right)^{\frac{1}{2}}. \tag{20}
\end{aligned}$$

Again,

$$\begin{aligned}
 & \int_a^b \frac{Q_2 \lambda^3 d\lambda}{(a^2 - \lambda^2)^{\frac{1}{2}} (\lambda^2 - b^2)^{\frac{1}{2}} (\lambda^2 - c^2)^{\frac{1}{2}}} \\
 &= \frac{c^3}{4} \int_a^b \frac{d\lambda}{\lambda (a^2 - \lambda^2)^{\frac{1}{2}} (\lambda^2 - b^2)^{\frac{1}{2}}} \\
 &= -\frac{c^3}{8} \int_{\frac{1}{a^2}}^{\frac{1}{b^2}} \frac{dv}{(a^2 v - 1)^{\frac{1}{2}} (1 - b^2 v)^{\frac{1}{2}}} \quad \left[v = \frac{1}{\lambda^2} \right] \\
 &= -\frac{c^3}{4ab} \left[\sin^{-1} \left\{ \frac{b^2 (a^2 v - 1)}{a^2 - b^2} \right\}^{\frac{1}{2}} \right]_{v=\frac{1}{a^2}}^{v=\frac{1}{b^2}} \\
 &= -\frac{\pi c^3}{8ab}. \tag{21}
 \end{aligned}$$

In order to evaluate the parts involving R_1 , R_2 , let us first assume

$$d\Omega = \frac{\lambda^3 d\lambda}{(a^2 - \lambda^2)^{\frac{1}{2}} (\lambda^2 - b^2)^{\frac{1}{2}} (\lambda^2 - c^2)^{\frac{1}{2}}},$$

and substitute

$$\begin{aligned}
 \lambda^2 &= a^2 \cos^2 \psi + b^2 \sin^2 \psi \\
 \lambda d\lambda &= -(a^2 - b^2) \cos \psi \sin \psi d\psi \\
 a^2 - \lambda^2 &= (a^2 - b^2) \sin^2 \psi \\
 \lambda^2 - b^2 &= (a^2 - b^2) \cos^2 \psi,
 \end{aligned}$$

which give

$$\begin{aligned}
 d\Omega &= -\frac{a^2 \cos^2 \psi + b^2 \sin^2 \psi}{(a^2 \cos^2 \psi + b^2 \sin^2 \psi - c^2)^{\frac{1}{2}}} d\psi \\
 &= -\frac{c^2 + \left\{ (a^2 - c^2) - (a^2 - b^2) \sin^2 \psi \right\}}{\left\{ (a^2 - c^2) - (a^2 - b^2) \sin^2 \psi \right\}^{\frac{1}{2}}} d\psi \\
 &= -\frac{c^2}{(a^2 - c^2)^{\frac{1}{2}}} \frac{d\psi}{(1 - k^2 \sin^2 \psi)^{\frac{1}{2}}} - (a^2 - c^2)^{\frac{1}{2}} (1 - k^2 \sin^2 \psi)^{\frac{1}{2}} d\psi,
 \end{aligned}$$

where

$$k^2 = \frac{a^2 - b^2}{a^2 - c^2}.$$

Hence we have

$$\Omega = -\frac{c^2}{(a^2 - c^2)^{\frac{1}{2}}} F(k, \psi) - (a^2 - c^2)^{\frac{1}{2}} E(k, \psi), \tag{22}$$

and since for

$$\begin{aligned}\lambda &= b, & \psi &= \frac{\pi}{2}, \\ \lambda &= a, & \psi &= 0,\end{aligned}$$

we have also

$$\left[\Omega \right]^{\lambda=b} = -\frac{c^2}{(a^2-c^2)^{\frac{1}{2}}} F_1 - (a^2-c^2)^{\frac{1}{2}} E_1$$

and

$$\left[\Omega \right]^{\lambda=a} = 0,$$

since the elliptic integrals F and E are taken between 0 and ψ .

Now

$$\begin{aligned}& \int_a^b \frac{R_1 \lambda^3 d\lambda}{(a^2-\lambda^2)^{\frac{1}{2}}(\lambda^2-b^2)^{\frac{1}{2}}(\lambda^2-c^2)^{\frac{1}{2}}} \\&= \frac{3}{8} \int_{\lambda=a}^{\lambda=b} \sin^{-1} \left(\frac{b}{\lambda} \right) d\Omega \\&= \frac{3}{8} \left[\Omega \sin^{-1} \frac{b}{\lambda} \right]_{\lambda=a}^{\lambda=b} + \frac{3b}{8} \int_{\lambda=a}^{\lambda=b} \frac{\Omega d\lambda}{\lambda (\lambda^2-b^2)^{\frac{1}{2}}} \\&= \frac{3\pi}{16} \left[\Omega \right]^{\lambda=b} - \frac{3b(a^2-b^2)^{\frac{1}{2}}}{8} \int_0^{\frac{\pi}{2}} \frac{\Omega \sin \psi d\psi}{a^2 \cos^2 \psi + b^2 \sin^2 \psi}. \quad (23)\end{aligned}$$

Similarly, we have

$$\begin{aligned}& \int_a^b \frac{R_2 \lambda^3 d\lambda}{(a^2-\lambda^2)^{\frac{1}{2}}(\lambda^2-b^2)^{\frac{1}{2}}(\lambda^2-c^2)^{\frac{1}{2}}} \\&= -\frac{3}{8} \int_{\lambda=a}^{\lambda=b} \sin^{-1} \left(\frac{c}{\lambda} \right) d\Omega \\&= -\frac{3}{8} \left[\Omega \sin^{-1} \frac{c}{\lambda} \right]_{\lambda=a}^{\lambda=b} - \frac{3}{8} \int_{\lambda=a}^{\lambda=b} \frac{\Omega d\lambda}{\lambda (\lambda^2-c^2)^{\frac{1}{2}}} \\&= -\frac{3}{8} \left[\Omega \right]^{\lambda=b} \sin^{-1} \left(\frac{c}{b} \right) \\&+ \frac{3c(a^2-b^2)}{8} \int_0^{\frac{\pi}{2}} \frac{\Omega \sin \psi \cos \psi d\psi}{(a^2 \cos^2 \psi + b^2 \sin^2 \psi)(a^2 \cos^2 \psi + b^2 \sin^2 \psi - c^2)^{\frac{1}{2}}} \quad (24)\end{aligned}$$

The required average value of the volume is obtained by substituting from (18), (19), (20), (21), (23), and (24) in (17), viz., we have

$$\begin{aligned} \frac{b-c}{abc} M &= \frac{\pi}{2} \left(\frac{8b}{3} - c - \frac{2c^3}{3ab} \right) \\ &- \frac{5b}{3} \cos^{-1} \left(\frac{b^2 - c^2}{a^2 - c^2} \right)^{\frac{1}{2}} + \frac{2b^3}{3ac} \sin^{-1} \frac{c}{b} \left(\frac{a^2 - b^2}{a^2 - c^2} \right)^{\frac{1}{2}} \\ &- \frac{\pi}{2} \left(1 - 2 \sin^{-1} \frac{c}{b} \right) \left\{ \frac{c^2}{(a^2 - c^2)^{\frac{1}{2}}} F_1(k) + (a^2 - c^2)^{\frac{1}{2}} E_1(k) \right\} \\ &- \frac{b(a^2 - b^2)^{\frac{1}{2}}}{a^2 - c^2} \int_0^{\frac{\pi}{2}} \frac{\Omega \sin \psi \, d\psi}{\epsilon^2 - k^2 \sin^2 \psi} \\ &+ \frac{c(a^2 - b^2)^{\frac{1}{2}}}{(a^2 - c^2)^{\frac{3}{2}}} \int_0^{\frac{\pi}{2}} \frac{\Omega \sin \psi \cos \psi \, d\psi}{(\epsilon^2 - k^2 \sin^2 \psi)(1 - k^2 \sin^2 \psi)^{\frac{1}{2}}}, \end{aligned} \quad (25)$$

wherein

$$\epsilon^2 = \frac{a^2}{a^2 - c^2},$$

and Ω is expressed in terms of elliptic functions by equation (22).

These two integrals occurring in the expression for M , can be expressed in terms of Jacobi's functions, viz., putting

$$\xi = \int \frac{d\psi}{\sqrt{1 - k^2 \sin^2 \psi}},$$

we have

$$\begin{aligned} \psi &= am \, \xi \\ d\psi &= dn \, \xi \cdot d\xi \\ \sin \psi &= sn \, \xi \\ \cos \psi &= cn \, \xi \end{aligned}$$

$$(1 - k^2 \sin^2 \psi)^{\frac{1}{2}} = dn \, \xi,$$

and

$$\begin{aligned} \int (1 - k^2 \sin^2 \psi)^{\frac{1}{2}} d\psi &= \int dn^2 \xi \cdot d\xi \\ &= \xi - k^2 \int \sin^2 \xi \cdot d\xi, \end{aligned}$$

which give, from (22),

$$\begin{aligned} \Omega &= -\frac{c^2}{(a^2 - c^2)^{\frac{1}{2}}} \xi - (a^2 - c^2)^{\frac{1}{2}} \xi + k^2 (a^2 - c^2)^{\frac{1}{2}} \int sn^2 \xi \cdot d\xi \\ &= -\frac{c^2}{(a^2 - c^2)^{\frac{1}{2}}} \xi - (a^2 - c^2)^{\frac{1}{2}} \left(N\xi + \xi \frac{E}{K} \right), \end{aligned}$$

so that the integrals become

$$\int \frac{\Omega \operatorname{sn} \xi. \operatorname{dn} \xi. d\xi}{e^2 + \operatorname{dn}^2 \xi}$$

and

$$\int \frac{\Omega \operatorname{sn} \xi. \operatorname{cn} \xi. d\xi}{e^2 + \operatorname{dn}^2 \xi}.$$

respectively.

It can easily be shown as follows that the result is expressible in terms of circular and logarithmic functions only when the ellipsoid degenerates into a prolate or an oblate spheroid. Thus, consider the portion of the definite integral in (17) which is due to R_1 and R_2 ; the since

$$R_1 + R_2 = \frac{3}{8} \sin^{-1} \left\{ \frac{b \sqrt{\lambda^2 - c^2} - c \sqrt{\lambda^2 - b^2}}{\lambda^2} \right\},$$

this portion becomes

$$\frac{3}{8} \int_a^b \frac{\lambda^3}{(a^2 - \lambda^2)^{\frac{1}{2}} (\lambda^2 - b^2)^{\frac{1}{2}} (\lambda^2 - c^2)^{\frac{1}{2}}} \sin^{-1} \left\{ \frac{b \sqrt{\lambda^2 - c^2} - c \sqrt{\lambda^2 - b^2}}{\lambda^2} \right\} d\lambda$$

Assume

$$\lambda^2 = \frac{b^2 - 2bc \cos \theta + c^2}{\sin^2 \theta},$$

which gives

$$\sqrt{\lambda^2 - b^2} = \frac{b \cos \theta - c}{\sin \theta}$$

$$\sqrt{\lambda^2 - c^2} = \frac{b - c \cos \theta}{\sin \theta}$$

$$b \sqrt{\lambda^2 - c^2} - c \sqrt{\lambda^2 - b^2} = \lambda^2 \sin \theta$$

$$\lambda d\lambda = - \frac{(b \cos \theta - c)(b - c \cos \theta)}{\sin^3 \theta} d\theta$$

Substituting, we get

$$\begin{aligned} & \frac{3}{8} \int \frac{\theta (-b^2 + 2bc \cos \theta - c^2) d\theta}{\sin^2 \theta \left\{ -a^2 \cos^2 \theta + 2bc \cos \theta + a^2 - b^2 - c^2 \right\}^{\frac{1}{2}}} \\ &= \frac{3}{8} \int \frac{\theta}{\sin^2 \theta} \sqrt{-a^2 \cos^2 \theta + 2bc \cos \theta + a^2 - b^2 - c^2} d\theta \\ &= \frac{3}{8} \int \frac{\theta d\theta}{\sqrt{-a^2 \cos^2 \theta + 2bc \cos \theta + a^2 - b^2 - c^2}}. \end{aligned}$$

In order that these may be reducible to logarithmic and trigonometric functions, the expression under the radical must be a perfect square, the condition for which is

$$b^2 c^2 = a^2 (b^2 + c^2 - a^2) \\ (c^2 - a^2)(b^2 - a^2) = 0$$

or

therefore, either

$$c^2 = a^2$$

or

$$b^2 = a^2$$

§ 4. Geometric Interpretation.

It is interesting to remark that the geometry of the ellipsoid furnishes an interpretation of the quantity called Ω in (22). First consider the ellipsoid

$$\frac{x^2}{a^2} + \frac{y^2}{\beta^2} + \frac{z^2}{\gamma^2} = 1;$$

then if S be its superficial area, we have, by Dr. Jellett's theorem,*

$$S = 2\pi\gamma^2 + 2\pi\alpha\beta \int_0^1 \frac{(1 - e^2 e'^2 x^2) dx}{(1 - e^2 x^2)^{\frac{1}{2}} (1 - e'^2 x^2)^{\frac{1}{2}}},$$

where

$$e^2 = \frac{a^2 - \gamma^2}{a^2}, \quad e'^2 = \frac{\beta^2 - \gamma^2}{\beta^2}.$$

Hence, if dS be an element of the superficial area, we have

$$\frac{dS - 2\pi\gamma^2 \cdot dx}{2\pi\alpha\beta} = \frac{1 - e^2 e'^2 x^2}{(1 - e^2 x^2)^{\frac{1}{2}} (1 - e'^2 x^2)^{\frac{1}{2}}} dx.$$

Assume

$$ex = \sin \theta, \quad edx = \cos \theta \, d\theta$$

Therefore

$$\begin{aligned} & \frac{dS - \frac{2\pi\gamma^2}{e} \cos \theta \, d\theta}{2\pi\alpha\beta} \\ &= \frac{1}{e} \frac{1 - e'^2 \sin^2 \theta}{\left(1 - \frac{e'^2}{e^2} \sin^2 \theta\right)^{\frac{1}{2}}} d\theta \\ &= \left(\frac{1}{e} - e\right) \frac{d\theta}{\left(1 - \frac{e'^2}{e^2} \sin^2 \theta\right)^{\frac{1}{2}}} + e \left(1 - \frac{e'^2}{e^2} \sin^2 \theta\right)^{\frac{1}{2}} d\theta, \end{aligned}$$

which is an expression of the same form as $d\Omega$.

* *Hermathena*, vol. iv, 1883, p. 477.

If now, we assume

$$\alpha = \sigma a, \quad \beta = \sigma \frac{ac}{b}, \quad \gamma = \sigma c,$$

where σ is a constant to be suitably chosen presently, we have

$$\begin{aligned} e^2 &= \frac{a^2 - c^2}{a^2}, & e'^2 &= \frac{a^2 - b^2}{a^2}, \\ \frac{e'^2}{e^2} &= \frac{a^2 - b^2}{a^2 - c^2} = k^2, & \frac{1}{e} - e &= \frac{c^2}{a(a^2 - c^2)^{\frac{1}{2}}}. \end{aligned}$$

Therefore

$$\begin{aligned} & \frac{dS - 2\pi \frac{\sigma^2 c^2 a}{\sqrt{a^2 - c^2}} \cos \theta d\theta}{2\pi \sigma^2 \frac{a^2 c}{b}} \\ &= \frac{c^2}{a \sqrt{a^2 - c^2}} \frac{d\theta}{\sqrt{1 - k^2 \sin^2 \theta}} + \frac{\sqrt{a^2 - c^2}}{a} \sqrt{1 - k^2 \sin^2 \theta} d\theta. \end{aligned}$$

As σ is an arbitrary quantity, we may, for the sake of symmetry, assume

$$\sigma = \frac{1}{ac},$$

so that now

$$\alpha = \frac{1}{c}, \quad \beta = \frac{1}{a}, \quad \gamma = \frac{1}{a}$$

and

$$\frac{dS - \frac{2\pi}{a \sqrt{a^2 - c^2}} \cos \theta d\theta}{\frac{2\pi}{bc}} = - \frac{d\Omega}{a}.$$

Hence if dS be the superficial element of the ellipsoid whose axes are reciprocal to those of the given ellipsoid, we have

$$S + \frac{2\pi}{abc} \Omega = \frac{2\pi}{a \sqrt{a^2 - c^2}} \sin \theta,$$

which is the geometrical relation in question furnishing the meaning of Ω .

§ 5. Canonical Form for Volume.

It may be observed that the expression for the common volume furnished by (12) involves two definite integrals A, B, whose values as given in (10) and (11) are not expressed in terms of known functions. They may easily be reduced to the standard elliptic forms, but that would only increase the difficulty of integration with respect to r . Thus, from (10), we have

$$A = \int_0^{\frac{\pi}{2}} \left\{ \frac{b^3 (a^2 - r^2) + a^2 (b^2 - r^2) \tan^2 \omega}{b^3 (a^2 - c^2) + a^2 (b^2 - c^2) \tan^2 \omega} \right\}^{\frac{3}{2}} d\omega.$$

Substitute

$$a^2 (b^2 - r^2) \tan^2 \omega = b^2 (a^2 - r^2) \cot^2 \theta,$$

so that for

$$\omega = \frac{\pi}{2}, \quad \theta = 0$$

$$\omega = 0, \quad \theta = \frac{\pi}{2}.$$

Again, from the above transformation,

$$\tan \omega = \frac{b}{a} \left(\frac{a^2 - r^2}{b^2 - r^2} \right)^{\frac{1}{2}} \cot \theta$$

$$\sec^2 \omega d\omega = -\frac{b}{a} \left(\frac{a^2 - r^2}{b^2 - r^2} \right)^{\frac{1}{2}} \frac{d\theta}{\sin^2 \theta}$$

$$\sec^2 \omega = \frac{a^2 b^2 - r^2 (b^2 \cos^2 \theta + a^2 \sin^2 \theta)}{a^2 (b^2 - r^2) \sin^2 \theta},$$

whence

$$d\omega = -ab (a^2 - r^2)^{\frac{1}{2}} (b^2 - r^2)^{\frac{1}{2}} \frac{d\theta}{a^2 b^2 - r^2 (b^2 \cos^2 \theta + a^2 \sin^2 \theta)}$$

Making these substitutions and putting

$$e^2 = \frac{a^2 - b^2}{b^2 - c^2} \frac{r^2 - c^2}{a^2 - r^2}, \quad \beta^2 = \frac{b^2 - c^2}{b^2} \frac{r^2}{r^2 - c^2},$$

we get

$$A = \frac{a}{b (b^2 - c^2)^{\frac{3}{2}} (a^2 - r^2)^{\frac{1}{2}}} \int_0^{\frac{\pi}{2}} \frac{d\theta}{(1 - \beta^2 e^2 \sin^2 \theta) (1 - e^2 \sin^2 \theta)^{\frac{3}{2}}}.$$

But since

$$\frac{1}{(1 - \beta^2 e^2 \sin^2 \theta) (1 - e^2 \sin^2 \theta)} = \frac{\beta^2}{\beta^2 - 1} \frac{1}{1 - \beta^2 e^2 \sin^2 \theta} - \frac{1}{\beta^2 - 1} \frac{1}{1 - e^2 \sin^2 \theta}$$

we have

$$\begin{aligned} & \int_0^{\frac{\pi}{2}} \frac{d\theta}{(1 - \beta^2 e^2 \sin^2 \theta) (1 - e^2 \sin^2 \theta)^{\frac{3}{2}}} \\ &= \frac{\beta^2}{\beta^2 - 1} \int_0^{\frac{\pi}{2}} \frac{d\theta}{(1 - \beta^2 e^2 \sin^2 \theta) (1 - e^2 \sin^2 \theta)^{\frac{1}{2}}} \end{aligned}$$

$$-\frac{1}{\beta^2-1} \int_0^{\frac{\pi}{2}} \frac{d\theta}{(1-e^2 \sin^2 \theta)^{\frac{3}{2}}}$$

But from a well-known transformation,* or from the identity

$$\frac{d}{d\theta} \frac{\sin \theta \cos \theta}{(1-e^2 \sin^2 \theta)^{\frac{1}{2}}} = \frac{1}{e^2} (1-e^2 \sin^2 \theta)^{\frac{1}{2}} - \frac{1-e^2}{e^2} \frac{1}{(1-e^2 \sin^2 \theta)^{\frac{3}{2}}},$$

we have at once

$$\int_0^{\frac{\pi}{2}} \frac{d\theta}{(1-e^2 \sin^2 \theta)^{\frac{3}{2}}} = \frac{1}{1-e^2} \int_0^{\frac{\pi}{2}} (1-e^2 \sin^2 \theta)^{\frac{1}{2}} d\theta,$$

and consequently

$$\begin{aligned} & \int_0^{\frac{\pi}{2}} \frac{d\theta}{(1-\beta^2 e^2 \sin^2 \theta) (1-e^2 \sin^2 \theta)^{\frac{3}{2}}} \\ &= \frac{\beta^2}{\beta^2-1} \int_0^{\frac{\pi}{2}} \frac{d\theta}{(1-\beta^2 e^2 \sin^2 \theta) (1-e^2 \sin^2 \theta)^{\frac{1}{2}}} \\ & \quad - \frac{1}{(1-e^2)(\beta^2-1)} \int_0^{\frac{\pi}{2}} (1-e^2 \sin^2 \theta)^{\frac{1}{2}} d\theta \\ &= \frac{b^2-c^2}{b^2} \cdot \frac{r^2}{b^2-r^2} P_1(-\beta^2 e^2, e) \\ & \quad - \frac{b^2(b^2-c^2)}{c^2(a^2-c^2)} \cdot \frac{(a^2-r^2)(r^2-c^2)}{(b^2-r^2)^2} E_1(e) \end{aligned}$$

By making a similar transformation, we have, from (11),

$$\begin{aligned} B &= \int_0^{\frac{\pi}{2}} \left\{ \frac{(a^2-r^2) + (b^2-r^2) \tan^2 \omega}{(a^2-c^2) + (b^2-c^2) \tan^2 \omega} \right\}^{\frac{3}{2}} d\omega \\ &= \frac{1}{(b^2-c^2)^{\frac{3}{2}}} \frac{(b^2-r^2)^2}{(a^2-r^2)^{\frac{1}{2}}} \int_0^{\frac{\pi}{2}} \frac{d\theta}{(1-\beta'^2 e^2 \sin^2 \theta) (1-e^2 \sin^2 \theta)^{\frac{3}{2}}}, \end{aligned}$$

where

$$\beta'^2 = \frac{b^2-c^2}{r^2-c^2}$$

* See my paper on "Poisson's Integral," J. A. S. B. 1888, vol. lvii, pt. ii, pp. 100-106.

and

$$\int_0^{\frac{\pi}{2}} \frac{d\theta}{(1 - \beta'^2 e^2 \sin^2 \theta) (1 - e^2 \sin^2 \theta)^{\frac{3}{2}}} \\ = \frac{b^2 - c^2}{b^2 - r^2} P_1(-\beta'^2 e^2, e) \\ - \frac{b^2 - c^2}{a^2 - c^2} \frac{(a^2 - r^2)(r^2 - c^2)}{(b^2 - r^2)^2} E_1(r).$$

Making these substitutions in (12), we get

$$V = \frac{\pi abc}{6} \\ - \frac{ac}{3b} \cdot \frac{b^2 - r^2}{(b^2 - c^2)^{\frac{1}{2}} (a^2 - r^2)^{\frac{1}{2}}} \left\{ b^2 P_1(-\beta'^2 e^2, e) - r^2 P_1(-\beta'^2 e^2, e) \right\};$$

and since

$$\frac{b-c}{8} M = \int_c^b V dr,$$

we have, by substituting for V and eliminating M between this equation and (25), a remarkable relation connecting four definite integrals.

§ 6. *Second Case.*

We now proceed to the consideration of the second case where only two of the vertices of the ellipsoid, *viz.*, the extremities of the longest axis, are outside the intersecting sphere, so that we have

$$a > r > b > c.$$

It is not necessary to repeat the whole of the previous calculation for this case, as by Prof. Catalan's beautiful transformation,* it may be made to depend on the preceding investigation. Thus, if we put

$$x = ax', \quad y = by', \quad z = cz'$$

$$\frac{r}{a} = c', \quad \frac{r}{b} = b', \quad \frac{r}{c} = a',$$

equations (1) and (2) are transformed into

$$x'^2 + y'^2 + z'^2 = 1 \\ \left(\frac{x'}{a}\right)^2 + \left(\frac{y'}{b}\right)^2 + \left(\frac{z'}{c}\right)^2 = 1.$$

We have also

$$c' < 1, \quad b' > 1, \quad a' > 1 \\ c' < b' < a' \\ a' > b' > 1 > c'.$$

* Problèmes de Calcul Intégral par E. Catalan, *Journal de Mathématiques* (Liouville), ser. i, t. vi (1841) pp. 419—440; cf. p. 439.

Hence these two surfaces have the same relation as the sphere and the ellipsoid in the present case. The volume common to these two surfaces may, therefore, be obtained from (12) by putting

$$a=a', \quad b=b, \quad c=c', \quad r=1.$$

Hence, remembering that

$$dx \, dy \, dz = abc \, dx' \, dy' \, dz',$$

we infer that the volume common to the surfaces

$$\begin{aligned} x^2 + y^2 + z^2 &= r^2 \\ \frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} &= 1 \end{aligned}$$

when

$$a > r > b > c$$

is obtained from (12) by writing

$$a = \frac{r}{c}, \quad b = \frac{r}{b}, \quad c = \frac{r}{a}, \quad r=1,$$

and then multiplying the result by abc .

Making these transformations in (10) and (11), we find, calling the new values of A, B, $\frac{a^3}{r^3}B'$, $\frac{a^3}{r^3}A'$, respectively,

$$\frac{a^3}{r^3}B' = \int_0^{\frac{\pi}{2}} \frac{a^3}{r^3} \left\{ \frac{r^2 - (b^2 \sin^2 \omega + c^2 \cos^2 \omega)}{a^2 - (b^2 \cos^2 \omega + c^2 \sin^2 \omega)} \right\}^{\frac{3}{2}} d\omega \quad \dots \quad (26)$$

$$\frac{a^3}{r^3}A' = \int_0^{\frac{\pi}{2}} \frac{a^3}{r^3} \left\{ \frac{r^2 (b^2 \cos^2 \omega + c^2 \sin^2 \omega) - b^2 c^2}{a^2 (b^2 \cos^2 \omega + c^2 \sin^2 \omega) - b^2 c^2} \right\}^{\frac{3}{2}} d\omega \quad \dots \quad (27)$$

Making these substitutions in (12) and multiplying the result by abc , we get for the required volume

$$V = \frac{4}{3}\pi r^3 - \frac{4}{3}a^3A' + \frac{4}{3}abcB'.$$

Hence, if M be the average value required, we have

$$\frac{M}{8} = \frac{\int_b^a V dr}{\int_b^a dr}$$

so that

$$\frac{a-b}{8}M = \int_b^a V dr$$

$$= \frac{\pi}{24} (a^4 - b^4) - \frac{1}{3} a^3 \int_b^a A' dr + \frac{1}{3} abc \int_b^a B' dr$$

which gives

$$\begin{aligned} & \frac{3(a-b)}{a} \left\{ \frac{M}{8} - \frac{\pi}{24} (a+b) (a^2 + b^2) \right\} \\ &= -\frac{1}{3} a^3 \int_b^a A' dr + \frac{1}{3} bc \int_b^a B' dr \quad \dots\dots\dots (28) \end{aligned}$$

If we compare the right hand side of this equation with the right hand side of (13), we find that, if in (13) we interchange a and c , we obtain exactly the same expression as in (28); similarly, the values of A' and B' in (26) and (27) are derivable from the values of A and B in (10) and (11) by interchanging a and c in the latter; hence, the value of the right hand side in (28) is obtained from the value of the right hand side of (13) by interchanging a and c in the latter.

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XII.—*A Descriptive List of the Uredineæ occurring in the Neighbourhood of Simla (Western Himalayas). Pt. II. Puccinia.*—By A. BARCLAY, M. B., Bengal Medical Service.

[Received 27th March ;—Read 3rd April, 1889.]

(With Plates XII., XIII., & XIV.)

In this second instalment of a descriptive list of the *Uredineæ* of Simla (commenced in this Journal, Vol. LVI, Pt. II, No. 3, 1887), I propose giving the characters of all the *Puccinia* with which I am acquainted, dividing them artificially into two classes, (a) those occurring on hosts other than the grasses (and sedges), and (b) those on the grasses and sedges. The former list is, I believe, fairly complete, but doubtless many additions will be made in future to the latter. These fungi on grasses are often so inconspicuous that they readily escape even trained observation.

I had hoped to have completed the list of *Æcidial* forms by describing those on the *Coniferæ*, one on *Jasminum grandiflorum*, L., and another on *Geranium*, sp., before proceeding to the telentosporic forms; but, as I must delay the publication of a description of the former until I shall have filled up certain gaps in my notes of them by further observation, I think it better to proceed with the other forms rather than to delay the whole series, more especially as my recent absence from India for a year has already interfered with work too long.

In the list now given, sixteen species are described in the first list, of which three, I believe, are new; and nine in the second list, of which four are perhaps new. In the case of those species which occur on grasses, it is extremely difficult to decide which should be considered new, and which should not. Any classification of them must remain extremely imperfect until their life-histories are known. Of the new species in the first list, that which I have named *Puccinia Rosæ* is interesting in giving rise to a powerful odour, and in possessing an all-pervading mycelium in the shoots attacked. *P. Galii*, Pers., exhibits an instance of very unusually long retained power of germination in the uredospores. *P. Rubiæ* appears to be a complete autœcious Uredine in which *æcidial* fructification has dropped out.\*

I have arranged the species in List I. under group headings *Leptopuccinia*, *Micropuccinia*, &c., as is done by Winter in his work†; but I

\* As this paper was passing through the press, I have been able to confirm this, and further details will be found in 'Scientific Memoirs by Officers of the Army of India', Part V.

† Die Pilze Deutschlands, &c.

have not attempted the same subdivision in List II., because I am by no means sure that uredospores are not produced in those cases in which I do not happen to have found them.

#### LIST I.

##### a. (*Leptopuccinia*).

##### 1. *PUCCINIA ROSÆ*, nov. sp.

on *Rosa macrophylla*, Lindl.

This curious fungus does not occur in Simla, but is abundant at Narkanda, some forty miles distant from Simla towards the interior. It is curious in several respects. In the first place the mycelium pervades the whole of the tissues of the shoots attacked, and almost every leaf in such a shoot bears spores. The affected shoots are paler in colour than normal and somewhat hypertrophied.

All attacked leaves are discoloured and much smaller and thicker than the normal ones. The diminished size is due to the fact that apparently only the young leaves are attacked and, when attacked, are arrested in growth. Another peculiarity in this fungus is that, when the spores are formed, the whole affected part of the plant has a most offensive foetid smell, which I can only compare with the smell of the stalk of flowers of certain *Arisæma*. It is a smell which suggests the attraction of flies to the part; but I never actually saw flies thus attracted. The only other *Puccinia* emitting a powerful odour with which I am acquainted is *P. suaveolens*, (Pers.), and this fungus likewise gives rise to deformity in the host's tissues. The fungus is so far away from Simla that I have had no opportunity for closely studying it. The mycelium appears to be perennial, but I have not been able to prove this. The teleutospore pustules are large, brown, and powdery, the spores being very deciduous, breaking off from their beds with only a fragment of stalk adhering to them. This fungus is met with in May and June: after that the parts bearing the fungus wither.

The spores when examined by transmitted light are orange-red, falling off readily from their beds with generally only a small fragment of stalk adhering. The spores measure about  $36\ \mu$  in total length, and 18 to  $22\ \mu$  in width at the septum. The epispore is very characteristically marked by longitudinal, or more frequently oblique, striation passing continuously over both cells, giving the spore a twisted appearance somewhat like the ovary of orchids. These striæ are interrupted ridges, as may readily be seen in empty spores after germination (Figs. 6, 7, Pl. XII). Placed in water they germinate readily immediately after ripening. The upper cells germinate first usually. The yellow contents of the spore wander



into the germ tube. The promycelium divides into four compartments, but usually only the distal three bear sporidia, though occasionally all four do so. Sterigmata are formed at the middle of the compartments, excepting in the case of the terminal cell, where the sterigma is terminal. The promycelium of the lower cells emerges from a point near the septum. The sporidia measure  $10\ \mu$  in diameter.

## 2. PUCCINIA URTICÆ, Barclay.

on *Urtica parviflora*, Roxb.

I have described this *Puccinia* elsewhere,\* but will here briefly recapitulate its characters. The leaves in autumn (October) often bear numerous pustules on the under surface, varying from the size of an ordinary pin's head to 3 mm. in diameter. These pustules are very convex towards the under surface of the leaf with a corresponding concavity above. The invaded areas are at first pale yellow both above and below, but afterwards become brown below and orange yellow with a pale green margin above. The pustules consist of aggregations of minute circular prominent spore beds. The spores are firmly adherent, brown, thickened at the apex, and vary greatly in size and shape (Fig. 9, Pl. XII). One of average size measures  $40\ \mu$  in total length (upper cell  $18\ \mu$  and lower  $22\ \mu$ ) and  $17\ \mu$  in greatest breadth. Double-headed spores are not uncommon. They germinate immediately after ripening in water, throwing out promycelia in 24 hours, the upper from the apex and the lower from a point near the septum. The sporidia measure  $12 \times 8\ \mu$ . No uredospores are ever formed so far as my observations extend. This *puccinia* has no connection whatever with the life history of the well known *Æcidium Urticæ*, Schum.

## 3. PUCCINIA SAXIFRAGÆ CILIATÆ, nov. sp.

on *Saxifraga ligulata*, Wal., var. *ciliata*, Royle.

This, so far as I am aware, is an uncommon parasite, and I have found it only in two localities. In one place, I found it in July, in the other, as early as the end of February. An attacked leaf displays a large number of minute dark chesnut-brown pustules about the size of an ordinary pin's head, always on the lower surface, each surrounded by a conspicuous yellow zone (Fig. 7, Pl. XIII). The unburst pustules are of a pale rosy yellow colour. They are very irregularly scattered over the surface of the leaf, and their positions beneath are indicated above by red spots. The spore beds are well raised and hemispherical. The spores are light brown

\* *Æcidium Urticæ*, Schum., var. *Himalayense*, 'Scientific Memoirs by Medical Officers of the Army of India' 1887, Part II, p. 38.

and firmly adherent to their beds, breaking off with a long piece of the stalk adhering ( $70\ \mu$  long in one case measured). Each cell has a clearly defined nuclear space (Fig. 8 a, b, Pl. XII). The free end of the spore is considerably thickened and pointed. The spore is elongated, spindle-shaped, well constructed at the septum, and narrowing at both ends (Fig. 8, Pl. XIII.) The whole spore measures when moist from  $51\text{--}65\ \mu$  in length, the upper cell from  $26\text{--}36\ \mu$  in length by  $16\ \mu$  in greatest breadth, and the lower from  $25\text{--}31\ \mu$  in length by  $14\ \mu$  in greatest breadth. The septum measures  $11\text{--}12\ \mu$  in breadth and the thickening at the free end  $6\text{--}11\ \mu$  in depth. After lying 24 hours in water some spores germinated throwing out short promycelia with colourless contents. The upper promycelium emerges from a point to one side of the apex, and the lower from a point near the septum. They did not go on to the formation of sporidia.

*Remarks.*—These characters do not agree with those given by Winter,\* for *P. Saxifraga*, Schlechtd., or *P. Adoxæ*, D. C. In the former case, the telentospore pustules are aggregated together in irregular and variously coloured areas (seldom isolated), and the spores are deciduous and much smaller than those of the Simla species. The telentospore beds of *P. Adoxæ* likewise coalesce, and the spores are deciduous and considerably smaller ( $30\text{--}45\ \mu$  long). In one point, however, there is a resemblance: in both the free end has often a pale lengthened thickening or projection. But, as *P. Adoxæ* is an autoecious *Enpuccinia*, I am inclined to regard the Simla species provisionally as distinct.

#### 4. PUCCINIA CIRCÆÆ, Pers.

on *Circæa alpina*, Linn.

This fungus is met with at higher elevations than Simla, namely, about 9000 feet. I found it occurring plentifully in the forests near the "Chor" mountain. Each attacked leaf usually displays numerous dark brown pustules on its lower surface (50 and more) varying in size from a minute point to 1 to 2 m. m. in diameter, and each surrounded by a zone of discolouration. Examined with a lens each pustule is seen to consist of numerous minute hemispherical beds aggregated together. The telentospores are firmly adherent and when scraped off become detached with a long piece of stalk adherent and usually come off in masses. The spores are very small, brown, elongated, constricted at the septum, much thickened at the free end with the lower cell narrowing towards the stalk (Fig. 11, Pl. XIV). The free end is more or less pointed. Herbarium specimens of spores when moistened measure from  $30$  to  $32\ \mu$  in total length (the upper and lower cells being usually equal in length)

\* Loc. cit.

and 7 to 9  $\mu$  in width at the septum. The apical thickening is 6 to 7  $\mu$  in depth.

*Remarks.*—This fungus is probably identical with *P. Oircææ*, Pers. I only once visited the locality where it occurs, in October, and do not know therefore whether earlier spores of a somewhat different character are formed as is the case with *P. Oircææ*.

### b. *Micropuccinia*.

#### 5. *PUCCINIA GERANII SILVATICI*, Karsten.

on *Geranium nepalense*, Sweet.

During April to June I have on several occasions found this plant attacked by a *Puccinia*-bearing mycelium with this peculiar character that, when it attacks the stem, as it frequently does, it gives rise to very considerable hypertrophy of the host's tissues. The fungus is by no means a common one and usually attacks the leaf blades, distorting and crumpling them (Fig. 10, Pl. XII), and forming spore beds in little dark reddish brown pustules on the under surface. A few isolated pustules occasionally open on the upper surface. The pustules are aggregated together in patches of various size, but generally large, sometimes involving half the whole surface of the leaf. On the leaf, the individual pustules are so closely packed together that a superficial examination would induce one to believe that the whole patch is one large spore bed. When the stem or petiole is attacked, the individuality of each pustule is more marked probably because of the hypertrophy always attending such cases. In one specimen I found the fungus had attacked a node of the stem where three shoots were given off, causing great hypertrophy (Fig. 11, Pl. XII) with pale rosy discoloration of the superficial tissues. Petioles were often found attacked and hypertrophied. The pustules on the stem and petioles were often oblong or linear. The mycelium apparently has a distinct preference for invading the vascular tissues, because, even when the leaf blade is attacked, it is frequently observed that the mycelium runs mainly along a main nerve, which is then hypertrophied, and the space in the angle between two attacked nerves is often filled with numerous confluent pustules. The upper surface of the leaf, opposite the spore pustules below, is pale and somewhat reddish. Small patches of invasion on the leaf blade are usually convex above, the lower or concave surface bearing the spore beds.

The spores are brown and powdery very easily detached from their beds with only a small fragment of stalk adhering. The upper and lower cells are usually equal in size, and there is little or no constriction at the septum. They are very uniform as a rule in size and shape (Fig. 12, Pl. XII).

A fresh typical spore just moistened measured  $30\ \mu$  in total length ( $15\ \mu$  to each cell) and  $16\ \mu$  in breadth at the septum. Spores which had lain some hours in water measured on an average as follows:—whole length  $30.6\ \mu$ ; length of upper cell  $15.6\ \mu$ ; length of lower cell  $14.8\ \mu$ ; breadth at septum  $17.6\ \mu$ . Among the spores were some fine paraphyses. There is a curious tendency in these spores to divide into more than two cells: for example I once saw a spore divided into 4 cells each  $10\ \mu$  in length, the breadth of the septa being  $19\ \mu$ ; on two other occasions I saw a spore divided into 3 cells suggesting a comparison with *Phragmidium* spores. The epispore is beset with coarse warts or tubercles over both cells. I frequently placed these spores in water with a view to observing their germination, but on two occasions only succeeded in seeing commencing germination only in the upper cell. In one case after five days I saw a spore with a promycelium from the free end of the spore  $22\ \mu$  long and  $8\ \mu$  broad with colourless granular contents. In another case I saw the same after 48 hours, but in neither case did development proceed any further.\*

*Remarks.*—I have named this species provisionally *Pucc. Geranii silvatici*, Karsten, but it is quite possibly a new species. It does not agree with the characters of *P. Geranii*, Cda.

### c. *Hemipuccinia*.

#### 6. *PUCCINIA ROSCOEÆ*, nov. sp.

on *Roscoe alpina*, Royle.

In September the leaves of this plant are often found attacked with a *Puccinia*-bearing fungus. Small pustules with a tendency to coalesce are found on the under surface of leaf blades, each surrounded by an area of paled tissue. Sometimes neighbouring areas coalesce, but as a rule each pustule remains distinct from its neighbour. Each pustule usually contains some uredopores also, which are oval, beset externally with a few spines, containing orange-yellow matter, and measuring  $28 \times 18\ \mu$  when moist (Fig. 1, Pl. XII). The teliospores measure when moistened  $32\ \mu$  in total length each, all being nearly equal in size ( $16\ \mu$  in length). The upper cell is usually somewhat broader than the lower, measuring  $17\ \mu$  against  $15\ \mu$ , and is thickened at its free extremity. The spore is constructed at the septum (Fig. 1, Pl. XII). These spores commence to germinate readily in water at once after ripening, but I have not observed the formation of sporidia. These are probably formed only

\* As this paper was passing through the press, I observed the complete development of promycelia in the normal way. The promycelia are short and bear sporidia measuring  $12 \times 6\ \mu$ . Secondary sporidia are occasionally formed.

after the spores have rested for a time. I only observed the germination immediately after ripening when a promycelium was emitted from each cell, that from the upper emerging from the apex, the other from a point near the septum (Fig. 1, Pl. XII). The promycelium measures about  $6\ \mu$  in diameter. I never observed the uredospores germinate.

#### 7. PUCCINIA FLOSCULOSORUM, (Alb. et Schw.)

on *Taraxacum officinale*, Wigg.

The leaves of this plant are frequently seen from Spring to Autumn bearing dark brown pustules mostly on their upper surfaces. Generally only the youngest entire leaves are thus attacked. Little or no discolouration of the leaf tissue is at first occasioned.

Each pustule contains numerous *Puccinia* and a few uredospores. These uredospores are chestnut-brown with resistant episporos beset with spines, and thus resemble *Uromyces* teleutospores rather than uredospores; but their germination reveals their true character (Fig. 3, Pl. XII). When wetted, they are round or oval, measuring  $24\ \mu$  in diameter, sometimes  $28 \times 22$  or  $20\ \mu$  (Fig. 2, Pl. I). Each uredospore has two germ pores. A few pale single-celled spores may also be found (Fig. 2, Pl. XII) with vacuoles; but these are probably immature uredospores.

The teleutospores are readily detached from their beds with only a fragment of stalk adhering. They are chestnut-brown, slightly constricted at the septum, rounded at both ends and thickened at neither (Fig. 2, Pl. XII). They measure when wetted  $36\ \mu$  in total length and  $22\ \mu$  wide at the septum, which usually divides the spore into two equal parts. The episporos of both upper and lower cell of the spore is distinctly tuberculated. I never succeeded in getting these spores to germinate.

*Remarks.*—This is probably *P. flosculosorum* (Alb. et Schw.) or *P. Taraxaci*, Plow, the characters of the uredo- and teleuto-spores agreeing in every respect. But while the European species is associated with æcidial fructification, this is never found in Simla. Two varieties of the European species are described,\* (a) *Forma crepidis* and (b) *Forma Hieracii* (Schum.) The former (a) is associated with an *æcidium*, the latter (b) is not. Magnus produced teleutospores of the latter (b) by sowing æcidiospores from *Taraxacum* on the leaves of *Hieracium*, sp. As we have no form (b) in Simla and no *Æcidium* on *Taraxacum*, it would appear that form (b) with its associated *Æcidium* is an entirely different fungus.

\* Winter, loc. cit., p. 207.

## 8. PUCCINIA GALII, Pers.

on *Galium aparine*, D. C.

This fungus may be found very largely distributed in autumn, commencing about October. Small circular dark brown pustules are formed on the under surfaces of the narrow leaves with often a paled yellowish area on the corresponding opposite or upper surface. Each leaf usually contained two, or three, or even more such pustules. I once counted 13 pustules on a single leaflet. These pustules contained *Puccinia* spores, with always a few uredospores, but, although I looked carefully earlier in the season, I never found simple uredo pustules.

The uredospores are oval, measuring  $23 \times 20 \mu$  when well moistened, with a brown tuberculated episporo. These spores germinate readily in water, throwing out a simple germ tube after the usual manner of uredospores (Fig. 5, Pl. XII). One such germ tube measured 0.315 mm. in length and  $5$  to  $6 \mu$  in diameter. Into this tube the protoplasm of the spores wandered, collecting in the distal end. Each spore appears to have two germ pores, but only one germ tube is emitted. A curious feature about those uredospores is the comparatively long time they retain their vitality. In a cultivation of teleutospores with material collected in October, and set in water on the 26th March following, all the uredospores present, of which there were several, germinated in 24 hours, whilst the teleutospores still remained *in statu quo*.

The teleutospores are brown bodies, not easily detached from their beds, and breaking off with a portion of stalk adhering. In each cell a distinct nuclear vesicle is seen. The spore is constricted in the middle at the septum, and the free end is considerably thickened. The septum usually divides the spore into equal halves (Fig. 4, Pl. XII). The whole length of the spore when well moistened is about  $44 \mu$ , and the breadth at the septum  $14 \mu$ . The greatest breadth of the upper cell is  $21 \mu$ , whilst that of the lower is  $16 \mu$ . The portion of stalk adherent to the detached spore is generally about  $30 \mu$  in length. The thickening of the free end of the spore is  $7$  to  $13 \mu$ . The above are average measurements, but the spores are not very uniform in size. These spores germinate freely in spring throwing out *promycelia* from the apex of the upper cell, or from a point a little to one side of it, and from a point near the septum of the lower cell. The *promycelia* as usual divide into 4 cells each forming a sporidium at the extremity of a sterigma. The sporidia measure about  $13 \times 9 \mu$  and germinate by throwing out a narrow germ tube  $2 \mu$  in diameter.

*Remarks.*—I have named this *P. Galii* and not *P. Valantiae*, Pers., as, on the whole, the characters of the teleutospore agree better with

those of the former. Moreover, the latter is a *Leptopuccinia* without uredospores. On the other hand, the uredospores of the former are somewhat larger than those I have described above, and the European species is associated with an *autæcious æcidium*, which we never find in Simla. Another difference in the Simla species is that the spore beds are always isolated, small, and circular, whilst those of *P. Galii* have a tendency to coalesce into irregular masses.

#### 9. PUCCINIA ACETOSÆ, Schum.

on *Rumex nepalensis*, Spr.

This fungus is very common in Simla and is chiefly remarkable for an apparent lichenoid symbiosis between the mycelium and the chlorophyll-containing cells of the host, such as is described by Dr. D. D. Cunningham, F. R. S., in *Ravenelia*.\*

The areas of the leaf blade invaded by the mycelium remain brilliantly green long after the rest of the leaf is yellow. The parasite is first met with in October, when the leaves may be seen to bear dark brown minute circular pustules, often with a distinctly circinate arrangement, both on the upper and lower surfaces, often in extraordinarily large numbers. At this time, if the spores be examined, they will be found to consist of round or oval single-celled bodies of a pale brown colour measuring from  $24\mu$  in diameter to  $28 \times 21\mu$ . These spores are easily detached from their beds without any portion of the stalk adhering as a rule. They have a fairly stout episporium beset with well marked warts, and are thickened very slightly at the free end (Fig. 13, Pl. XII). The contents are sometimes finely granular throughout, but frequently several oil globules are found in the granular protoplasm. These are uredospores, and they germinate readily in water, throwing out very long simple germ tubes. I have found uredo pustules with a few teleuto-spores in them in March on green leaves, and the spores from them germinate very readily. I do not know whether these pustules had developed recently, or whether they had remained over from the previous autumn. My impression is that they were of quite recent formation. Later, the same pustules produce *puccinia*, which are brown, rounded, and with little or no constriction at the septum (Fig. 13, Pl. XII). These spores are very readily detached from their beds, breaking off with only a minute fragment of the stalk adhering. They have a characteristic knob-like thickening at the free end. The total length of the moistened spores varies from 40 to 32  $\mu$ , and the breadth at the septum from 18 to

\* On a new Genus of the Family *Ustilaginæ*, 'Scientific Memoirs by Medical Officers of the Army of India,' Part III, p. 31.

22  $\mu$ . The average length is 35  $\mu$ , and the average breadth at the septum, which usually divides the spore into two equal parts, is 19.8  $\mu$ . I have never observed the germination of these spores.

*Remarks.*—These characters agree on the whole with those of *P. Acetosæ*, and I think there can be no doubt that the European and the Simla forms are identical. In the Simla species I have never observed pustules on the petiole or stalk as in the European species.

#### • 10. PUCCINIA HELVETICA, Schröter.

on *Rubia cordifolia*, Linn.

In July, soon after the rains have commenced, this plant puts out new leaves, which are early attacked by a uredo-bearing fungus, differing from most similar fungi in the uredo-pustules being brown and being intimately associated with spermogonial production. On the upper surface of the leaf, a number of pale yellow circular patches are seen, irregularly scattered about, each measuring about 3 mm. in diam. (Fig. 5, Pl. XIII.) The number of pustules on each leaf varies from one to 120, and even more. Within the paled circular area, a circle of minute brown uredo pustules are produced, which sometimes remain separate, but which sometimes coalesce laterally, and within this brown circle, in the centre of the yellow patch, is a group of spermogonia. Viewed from the lower surface (Fig. 4, Pl. XIII) of the leaf, the yellow discoloration is less marked, but the circinate arrangement of uredo pustules is even better marked than above, and, in the centre, on the lower surface also, is a smaller group of spermogonia. The circles of brown uredo pustules on the upper and lower surfaces of the leaf are exactly opposite each other.

Those brown pustules contain brown uredospores, borne singly on stalks, with a few paraphyses among them. The spores, which are oval, are readily detached, coming off without any portion of stalk adhering, although the place of union with the stalk is generally clearly recognisable on the detached spore. The spores have a well defined epispore beset with sharp spines, and, when just wetted with water, measure on an average  $26.8 \times 21.2 \mu$ . The stalks measure about 50  $\mu$  in length. These uredo pustules are found also on the petioles and stalks.

In the autumn, when the persistent leaves are drying, they are covered with black teleutospore beds, mostly exhibiting the same circinate arrangement above described, but many are also isolated as shown in (Fig. 6, Pl. XIII). These teleutospore pustules are mostly on the upper surface of the leaf, but a great many are formed also on the under surface. The dried leaves remain attached to the dry stalks throughout \*



the winter, and, indeed, do not fall off until the rains commence, when they fall, but by this time new young leaves have already been unfolded. It would thus appear that the teleutospores germinate at the commencement of the rains, infecting the new leaves, though a few experiments I made with a view to verifying this did not succeed.\* If infection of the new leaves by the teleutospores on the old ones does actually take place, we have an autœcious Uredine in which the æcidial fructification has dropped out, for I am quite certain that no æcidium is produced by this fungus. It, however, remains to be proved that the teleutospores give rise to the production of uredospores. In the meantime, the fungus must be classed with such forms as *P. suaveolens*, (Pers.), *P. Oreoslini* (Strauss), and *P. Vincæ*, D. C., among the *Hemipuccinia*, all of which produce spermogonia together with uredo- and teleuto-spores, without any æcidium.

The teleutospores are plump brown spores, constricted at the septum, with well marked apical thickening, which is rounded usually, but which is sometimes conical either in the centre or laterally. The lower cell narrows towards the stalk, which is long and adherent. The surface of the epispore is smooth (Fig. 14, Pl. XII). Each cell usually displays a clear nuclear vesicle. The freshly gathered spores, when moistened, measure from 49 to 54  $\mu$  in total length (upper cell from 25 to 30  $\mu$ , and lower 24  $\mu$ ) and 13 to 15  $\mu$  at the septum. The apical thickening is 8 to 9  $\mu$  in depth.

*Remarks.*—I have called this *P. helvetica* with some hesitation. In the European species no mention is made of the existence of spermogonia, a prominent and invariable feature in the Simla species; but the measurements of the uredo and teleutospores correspond fairly well.

# 11. PUCCINIA MENTHÆ, Pers.

on *Origanum vulgare*, Linn.

While writing this list, I found, in March, this host harbouring a *Puccinia*-bearing fungus. Some plants were very extensively attacked, bearing dark brown pustules on the under surface of the blade. The pustules are small, round, and hemispherical, and do not tend to coalesce. Sometimes each leaf bears a very large number of such isolated pustules, sometimes only one. The position of these pustules is indicated on the upper surface of the leaf by dark spots surrounded by a zone of slightly paled tissue. The pustules contain both brown uredospores and teleutospores, the former the more numerous (at this season at any rate). Both spores are very easily detached from the spore bed.

\* As this paper was passing through the press, I succeeded in reproducing the uredo stage with the sporidia of teleutospores gathered in the preceding autumn.

The uredospores are light brown, mostly round, some oval or pyriform, with a tuberculated or spiny epispore. They measure, when just moistened, about  $25\ \mu$  in diameter. They germinate very readily in water, throwing out an ordinary germ tube, simple and unbranched. When germinating, they are seen to possess 2 to 3 germ pores.

The teleutospores fall off easily, with a short piece of stalk adhering. They are brown, rounded at both ends, little or not at all constricted at the septum, without apical thickening as a rule, and with a tuberculated or spiny epispore. When just wetted, they measure about  $28\ \mu$  in total length by  $20\ \mu$  at the septum. The septum divides the spore into two equal halves. These spores also germinate readily at once. The promycelium is short, and usually produces 3 to 4 sporidia on very short sterigmata. The sporidia are oval, measuring  $8.5 \times 6.5\ \mu$  to  $10 \times 8\ \mu$ . They germinate readily, throwing out a fine long germ tube (Figs. 15, 16, Pl. XII).

*Remarks.*—I have called this *P. Menthae*, provisionally, as the uredospores and teleutospores agree in characters with those of that species. It must be observed, however, that the æcidium is unknown here, and I have therefore placed the parasite under *Hemipuccinia*, and not under *Auteupuccinia*, as is of course done in Europe, where the æcidium also occurs on the same host. In this respect, both this Indian species and that on *Taraxacum officinale* (see above) are interesting in being unaccompanied by æcidial fructification. Biological evidence may show, later, either that the species is distinct from the European, or that the æcidial fructification on the same host in Europe is not genetically related with the uredo- and teleuto-spores.

#### d. *Eupuccinia* (heterœcious).

#### 12. PUCCINIA POLLINIÆ, Barclay.

on *Pollinia nuda*, Trin.

This is an exceedingly abundant species, and is related to the *Æcidium* on *Strobilanthes Dalhousianus*, Clarke (*Æcidium Strobilanthis*, Barclay\*). Uredopustules are situated mostly on the under surface of the leaf, and are not numerous: they are oval or shortly linear. The uredospores are pale brown, and the epispore is beset with tubercles. They measure on an average  $21.6 \times 20.2\ \mu$ .

The teleutospore beds are usually very numerous on each attacked leaf, mostly in the lower surface; they are long, linear, and black. The spores germinate readily immediately after ripening, as well as after a

\* On the Life History of a new *Æcidium* on *Strobilanthes Dalhousianus*, Clarke. 'Scientific Memoirs by Medical Officers of the Army of India,' Part II, Calcutta, 1887.

winter rest. They are firmly adherent, and a portion of stalk remains on detached spores. The spores are rounded at both ends, but little constricted at the septum, and with the free end slightly thickened. The episore is studded with fine tubercles. The spores measure  $36\mu$  in total length, and  $16\mu$  at the septum. The upper promycelium emerges from the apex of the spore, a little to one side, and the lower from a point near the septum. The sporidia measure from  $10 \times 6\mu$  to  $12 \times 7\mu$  (see also J. A. S. B., Vol. LVI, Pt. II, No. 3, 1887).

### 13. PUCCINIA CARICIS, Schum.

on *Carex setigera*, Don.

This is a widely distributed species and stands in genetic relationship with *Æcidium Urticæ*, Schum, var. *Himalayense*, Barclay.\*

Uredopustules are not very numerous, and are found on the upper surfaces of the leaves: they are inconspicuous, small, brown, and linear or oblong. The spores are elliptical or pyriform, and are beset with prominent tubercles. They are pale yellow, and measure on an average from  $19.8 \times 13.5\mu$  to  $19.2 \times 12.8\mu$ .

The teleutospore pustules are minute, circular, and black, mostly on the upper surfaces of the leaves. The spores are dark brown, firmly adherent, constricted at the septum, thickened at the free end, and usually narrowing towards the stalk. They germinate readily immediately after ripening as well as after a winter rest. They measure on an average  $56\mu$  in total length and  $15\mu$  at the septum. The promycelium of the upper cell emerges from the apex, and that of the lower, from a point near the septum. Four sporidia are formed usually on each promycelium, measuring  $12 \times 8\mu$ .

#### e. *Epuccinia* (antœcious.)

### 14. PUCCINIA VIOLÆ, Schum.

on *Viola serpens*, Wall.

### 15. PUCCINIA FRAGARIÆ, Barclay.

on *Fragaria vesca*, Linn.

For descriptions of these two *Puccinia*, see J. A. S. B., Vol. LVI, Part II, 1887.

### 16. PUCCINIA PIMPINELLÆ, Strauss.

on *Pimpinella diversifolia*, D. C.

I have described the characters of this fungus in the Journal of

\* 'Scientific Memoirs by Medical Officers of the Army of India,' Part II, 1887.

this Society above quoted. I then noted that the teleutospores are formed in autumn, and that I had not observed their germination. Early this Spring (middle of February), however, I observed a few young *seedlings* with teleutospore pustules on the young green leaves of the same characters as those I found in autumn, and these germinated early in March in water. The promycelium of the upper cell emerges from the upper half of the upper cell, but not from its apex (see Fig. 12, Pl. XIII), whilst that from the lower cell emerges from a point nearer the stalk than the septum, and takes a course in a direction opposite to that of the upper promycelium. The sporidia are long narrow bodies, about  $26\mu$  to  $18\mu$  in length and  $8\mu$  in width, on short pointed sterigmata, and the promycelial tube opposite a sterigma is about  $10\mu$  in diameter. The sporidia frequently germinate while still attached to the promycelium.

Early in March, I found similar young seedlings already attacked by an *Aecidium*, but, although I made several attempts to reproduce the *aecidium* with these freshly gathered and germinable teleutospores, I did not succeed. I am therefore forced to believe that the teleutospores are not genetically related with the *aecidium*-bearing fungus on the same host. The matter requires further investigation.

## LIST II.

### 17. PUCCINIA ARUNDINELLÆ, nov. sp.

on *Arundinella setosa*, Trin., and *A. Wallichii*, Nees.

This fungus is not uncommon. The teleutospore beds are oval or slightly linear on the under surface of the blade. The uredo pustules are peculiarly brilliant brick red, and are formed in July and August. The teleutospores are brown bodies slightly constricted at the septum, somewhat thickened at the free end, and breaking off usually with a long portion of stalk adhering (Figs. 7, 8, Pl. XIV). In each cell a nuclear vesicle is often present. The whole length of the spore when moistened is about  $46\mu$ , of which  $24\mu$  belong to the upper cell, and  $22\mu$  to the lower. The breadth at the septum is about  $20\mu$ . After a winter's rest, these spores readily germinate in water, each cell throwing out a characteristic promycelium. That from the upper cell usually emerges first from the apex of the spore, while that from the lower cell issues from a point near the septum (Fig. 7, Pl. XIV). Each promycelium forms four sporidia on as many sterigmata, and the sporidia, which are oval or kidney-shaped, measure on an average  $10 \times 7\mu$ , varying from  $9 \times 5\mu$  to  $11 \times 7\mu$ . The portions of stalk adhering to the spore measure 110 to  $120\mu$  in length.

This fungus on *A. Wallichii* is not common. It forms linear black pustules on the lower surface of the leaf. I have not found uredospores on this host. The teleutospores are brown, rounded at both ends, equally divided into two by the septum, not constricted at the septum and thickened at the free end. Freshly gathered spores moistened measure on an average  $40\ \mu$  in total length and  $18\ \mu$  at the septum. The thickening at the free end measures about  $8\ \mu$  in depth. The free end is usually rounded, but sometimes more or less pointed. The spores break off from their beds with a long piece of stalk adhering (Fig. 11, Pl. XIII).

*Remarks.*—I have grouped these two fungi together, as the teleutospores resemble one another closely; but subsequent observation may prove them to be distinct. It is I believe a new species.

#### 18. PUCCINIA ANDROPOGI, Schw.

on *Andropogon tristis*, Nees.

This is not a common fungus, and I have only found teleutospores. Pustules of these spores are formed on the lower surface of the leaf; they are linear or oval, tending to coalesce, and very numerous on each attacked leaf. The spores are firmly adherent, in long stalks, brown, rounded usually at both ends, and thickened at the free end. The spore is slightly constricted at the septum (Fig. 13, Pl. XIV). Freshly gathered spores, when moistened, measure from  $34$  to  $41\ \mu$  in total length; the upper cell varies from  $17$  to  $21\ \mu$  and the lower from  $16$ — $20\ \mu$ . The width at the septum is  $16$  to  $22\ \mu$ , and the apical thickening about  $8\ \mu$  in depth.

*Remarks.*—Two species of *Puccinia* on species of *Andropogon* are described in America,\* one referred to *P. Phragmitis* (Schum) and the other to *P. Andropogi*, Schw. If the Indian species is identical with either, it is more probably with the latter, and I have therefore named it accordingly for the present.

#### 19. PUCCINIA ANTHISTIRIÆ, nov. sp.

on *Anthistiria anathera*, Nees.†

The leaves, haulms, and glumes of this grass are often attacked by a fungus, bearing large conspicuous beds of sooty black teleutospores, sometimes so confluent, and so largely involving the surface area of the part attacked as to suggest the idea that it is one of the *Ustilaginæ*. Small linear or oval beds are also met with, and indeed the large beds are the result of the coalescence of these primarily small beds. The

\* Bulletin of the Illinois State Laboratory of Natural History, vol. ii, art. iii, Parasitic Fungi of Illinois, pt. i, by T. J. Burrill, 1885.

† I am not quite certain that this host has been correctly determined: it may prove to be a species of *Bromus*.

spores are very firmly adherent, and, when scraped off, become detached with a long piece of stalk attached (Fig. 6, Pl. XIV). The spores are spindle-shaped, pale brown when seen by transmitted light, well constricted at the septum, and with a distinct apical thickening. Each cell of the spore usually displays a clearly defined nuclear vesicle. The fresh spore, when moistened, measures on an average  $45.6 \mu$ ; the upper cell is usually a little longer than the lower, which contracts towards the stalk. The width at the septum is about  $13 \mu$ , and the thickening at the free end is  $6$  to  $7 \mu$ . Towards the end of March these spores germinate in the usual way. The sporidia are oval, and measure  $8 \times 6 \mu$ . I have not met with any uredospores on this grass.

*Remarks.*—This is probably a new species.

## 20. PUCCINIA CHRYSOPOGI, nov. sp.

on *Chrysopogon gryllus*, Linn

This is a very abundantly distributed parasite, forming well raised plump, oval, or broadly linear dark brown pustules: they germinate very readily in spring in water. After 24 hours in a water cultivation they were observed to have thrown out long promycelia, into the distal ends of which the orange-yellow contents of the spore had wandered. The end of the promycelium divides into four cells, each of which produces a sporidium on unusually long sterigmata. The sporidium ( $14 \times 12 \mu$ ), which is oval, often germinates while still attached to the sterigma, forming a secondary sporidium. The germ tube of the primary and secondary sporidium is often slightly spiral (Fig. 10, Pl. XIV). The promycelium of the upper cell emerges from a point near the apex of the cell, and that from the lower from a point near the septum (Fig. 9, Pl. XIV). The promycelia were often observed to acquire unusual forms, such for example as is represented in the figure, where the promycelium of the upper cell has divided into three cells, two of which have thrown out remarkably long and stout sterigmata, which, however, remained sterile. The cultivation was in water. The spores are slightly constricted at the septum, and the apex is little if at all thickened. On an average the moistened spore measures  $43 \mu$  in total length, and  $24 \mu$  at the septum. In each cell a well defined nuclear vesicle is usually seen. The detached spore has usually a very small portion of the stalk adhering to it. The spores are firmly set in their beds.

The teleutospores are preceded by uredospores, which are round or oval orange-red bodies. Young teleutospores are often seen in fully developed uredopustules. The uredospores measure, when moistened, from  $23 \mu$  in diameter to  $33 \times 26 \mu$ , the average being  $28.7 \times 26.5 \mu$ .

*Remarks.*—This is probably a new species.

## 21. PUCCINIA CORONATA, Corda.

A. on *Brachypodium sylvaticum*, Beauv.

This fungus is not very common, and is usually found in localities where an *Æcidium* on *Rhamnus dahuricus*, Pall., occurs. I have already expressed my belief that it is related to this *æcidium*,\* although I have not been able to prove it by experiment. The telentosore beds form very minute black points on the upper surfaces of the blade, sometimes arranged linearly; but they never coalesce to form linear beds. The uredo pustules are much larger, orange-yellow, and also on the upper surface of the leaf.

The uredospores are pale saffron-yellow bodies, with a finely punctated episore, measuring when just moistened 20 to 24  $\mu$  in diameter (Fig. 3, Pl. XIII). They germinate in the usual way by throwing out a single germ tube. There are three or four germ pores, but only one germ tube is emitted (Fig. 5, Pl. XIV).

The telentospores are brown with the characteristic crown of generally regularly arranged processes (Fig. 3, Pl. XIII and Figs. 1, 4, Pl. XIV). They are borne on short stalks, and each cell usually displays a well defined nuclear vesicle. The total length of the just moistened spores is 38 to 44  $\mu$ , the upper cell measuring from 18 to 22  $\mu$ , and the lower, 19 to 26  $\mu$ ; the width at the septum is 10 to 11  $\mu$ . The spore narrows gradually towards the stalk, and is scarcely at all constricted at the septum. They do not germinate until after a winter's rest. In the spring they germinate freely; the promycelium from the upper cell emerging from a point immediately under the crown (Fig. 1, Pl. XIV), and that from the lower cell, from near the septum. Four sporidia are usually formed at the ends of short pointed sterigmata (Fig. 1, Pl. XIV). The sporidia are oval bodies measuring on an average  $11 \times 6.8 \mu$ , varying from  $10 \times 6 \mu$  to  $13 \times 9 \mu$ . They germinate readily (Fig. 2, Pl. XIV). The promycelium at the base measures 6 to 7  $\mu$ , but opposite the sterigmata only 4 to 5  $\mu$ .

B. on *Chrysopogon ceruleus*, Nees.

This is an uncommon parasite resembling the above in the telentospores being coronated, but I am inclined to think it is a distinct species, because the spores themselves have a different form, and the crown of processes is usually very irregular, contrasting with the usually regular crown of the fungus above described. Other noteworthy differences are the following:—The telentosore pustules are *linear*, and on the lower surface of the leaf. Uredopustules are placed also on the under

\* J. A. S. B. vol. lvi, pt. ii, no. 3, 1887.

surface, and these are produced throughout the winter, as I have found them late in autumn, and very early in February, whilst I have never found the uredo pustules of the foregoing fungus after summer.

The uredospores are circular, oval or pyriform, and, when just moistened, vary from  $17\ \mu$  in diameter to  $26 \times 21\ \mu$ . Their contents are pale orange-yellow, but their coloured matter is characteristically confined to the centre of the spore, leaving a colourless periphery about  $2\ \mu$  in depth; the epispore is smooth (Fig. 3, b, Pl. XIV).

The teleutospores are adherent, falling off with a small portion of stalk attached. The crown processes, as already noted, are remarkably irregular, and the individual processes are often very long (Figs. 9, a, b, c, Pl. XIII and Fig. 3, a, c, Pl. XIV). The freshly gathered spores, when just moistened, have the following dimensions:—whole length 43 to  $55\ \mu$ , the mean being 49 to  $50\ \mu$ ; the upper cell on an average  $25\ \mu$  long, and the lower  $24\ \mu$ ; the breadth at the septum 8 to 12 or  $14\ \mu$ . These spores, I found, germinated very freely in water so early as the 15th February, when most other teleutospores were still incapable of doing so, and when the spores of the foregoing fungus only commenced to germinate, without proceeding to the formation of sporidia. The lower cell usually germinated first. Four sporidia are usually formed on each promycelium; these are oval and measure about  $9 \times 7\ \mu$ .

C. on *Agrostis Hookeriana*, Manw.

A third form occurs on *Agrostis Hookeriana* with characters more nearly resembling form B. than form A. The teleutospores are almost identical in form and measure 44 to  $50\ \mu$  in total length, and 8 to 10 at the septum (Fig. 12, Pl. XIV). In the absence of biological data, however, it is impossible to say definitely whether all these forms belong to one species, but until these are forthcoming they may conveniently be grouped together. I have not seen any uredo form on *Agrostis*.

22. PUCCINIA GRAMINIS, Pers.

on *Festuca gigantea*, Vill.

In certain localities this *Puccinia* is very abundant. The teleutospore beds are very narrow and long, forming black lines on the upper surface of the blade. These pustules, when not very numerous on a single leaf, are generally found on the distal half, but otherwise the whole of the upper surface is uniformly involved.

Saffron-yellow uredopustules, mostly on the lower surface, precede the formation of teleutospores. The uredospores are round or oval, and orange-yellow, with an epispore beset with spines. The orange-yellow contents are often aggregated in the centre, leaving the periphery filled



with granular uncoloured matter. The fresh spores measure on an average  $30.6 \times 27.6 \mu$  varying from  $28 \mu$  in diameter to  $32 \times 28 \mu$ .

The teliospores are long, narrow, and characteristically square shaped (Fig. 10, Pl. XIII), the free end being squarely thickened. The total length of the fresh spore, when moistened, varies between  $34$  and  $41 \mu$ ; the upper cell measuring  $16$  to  $20 \mu$  in length, and the lower,  $17$  to  $21 \mu$ . At the septum the breadth of the spore is  $8$  to  $10 \mu$ .

*Remarks.*—I have named this *P. graminis*, as I find Plowright\* mentions the same host as bearing this species, although the measurements of my teliospores are smaller than those given by him. The Berberry æcidium, as I have already noted, is very common in Simla.

### 23. PUCCINIA CARICIS FILICINÆ, nov. sp.

on *Carex filicina*, Nees.

This is not a common fungus, and is usually very inconspicuous, bearing very minute circular teliospore beds (resembling in this respect the same beds of *P. caricis* on *Carex seligera*, which, though small, are yet considerably larger than those on *Carex filicina*). Only a few minute spore beds are usually formed on each leaf, and always on the lower surface. Spore beds are also occasionally formed on the sheath. I have not seen any uredo pustules on this plant.

The teliospores are borne on long stalks, and are firmly adherent. They are brown, much constricted at the septum, and thickened at the free ends (Fig. 1, Pl. XIII). When freshly gathered and moistened, a representative spore measured  $44 \mu$  in total length, of which  $24 \mu$  belonged to the upper cell, and  $20 \mu$  to the lower. The breadth at the septum was  $12 \mu$ , and the apical thickening was  $8 \mu$  in depth. These spores germinate freely in spring in water, after a winter's rest. The promycelium of the upper cell emerges from the apex, through a pore which is clearly visible before germination, and that of the lower, from a point near the septum. Each promycelium usually produces four sporidia in the usual way (Fig. 2, Pl. XIII). The sporidia are oval, somewhat more pointed at the attached end than at the free end, and measure  $9 \times 6 \mu$  to  $12 \times 6 \mu$ . These sporidia usually emit a germ tube from the side, and not from either end.

*Remarks.*—I frequently placed these teliospores on leaves of *Urtica parviflora*, Roxb., but the well known *Æcidium Urticæ*, Schum, was never produced. It is therefore certainly distinct from *P. Caricis*, Schum. The characters of *P. limosæ*, Magnus, and *P. silvatica*, Schröter, do not agree with those above described.

The former is connected with an *Æcidium* on *Lysimachia*, and we

\* British Uredineæ and Ustilagineæ, Plowright, Keegan, Paul, Trench & Co., 1889.

have no corresponding *Æcidium* in Simla, and the latter, with an *Æcidium* on *Taraxacum*, and we have similarly no corresponding *Æcidium* here. The only *Æcidium* on any member of the *Compositæ* that I have met with is that on *Myriactis nepalensis*, Less., and I have never found it actually in Simla.\* I must therefore regard this *Puccinia* as a new species, at any rate for the present.

## DESCRIPTION OF THE PLATES.

## PLATE XII.

Fig. 1. *Puccinia Roscoeæ*, uredospore and two telutospores; one with two promycelia. 2. *P. fusculosorum*, two uredospores and one telutospore. 3. *P. fusculosorum*, uredospore germinating. 4. *P. Galii*, telutospore. 5. *P. Galii*, uredospore germinating. 6. *P. Rosæ*, telutospore showing commencing germination in upper cell,  $\times 400$ . 7. *P. Rosæ*, telutospore showing promycelium of upper cell with two sporidia,  $\times 400$ . 8. *P. Rosæ*, sporidium germinating,  $\times 250$ . 9. *P. Urticæ*, telutospores, with branched promycelium from lower cell. 10. *P. Geranii silvatici*, natural appearance of attacked leaf, natural size. 11. *P. Geranii silvatici*, showing hypertrophied node caused by mycelium, natural size. 12. *P. Geranii silvatici*, telutospore, after lying 24 hours in water,  $\times 400$ . 13. *P. Acetosæ*, two uredospores and one telutospore. 14. *P. helvetica*, telutospore. 15. *P. Menthæ*, germinating telutospore with sporidia. 16. *P. Menthæ*, germinating sporidium.

## PLATE XIII.

Fig. 1. *Puccinia Caricis flicinæ*, germinating telutospore. 2. *P. Caricis flicinæ*, end of promycelium showing sporidial formation. 3. *P. coronata*, from *Brachypodium sylvaticum*, showing representative telutospore and uredospore. 4. *P. helvetica*, lower surface of leaf in uredo stage. 5. *P. helvetica*, upper surface of leaf in uredo stage. 6. *P. helvetica*, upper surface of leaf in telutospore stage. 7. *P. Samifragæ ciliatæ*, natural appearance. 8, a. & 8, b. *P. Samifragæ ciliatæ*, telutospore. 9. *P. coronata*, from *Chrysopogon cœruleus*: a, showing an upper cell with promycelium and sterigmata, from which the sporidia have fallen: b, germinating sporidium: c, another telutospore. 10. *P. graminis*, telutospore. 11. *P. Arundinellæ* on *A. Wallichii*, telutospore. 12. *P. Pimpinellæ*, germinating telutospore with sprouting sporidia still attached.

## PLATE XIV.

Fig. 1. *Puccinia coronata*, from *Brachypodium sylvaticum*, telutospore with promycelium. 2. *P. coronata*, germinating sporidia. 3. *P. coronata*, from *Chrysopogon cœruleus*; a. and c., forms frequently met with on this host: b., two uredospores are also shown. 4. *P. coronata*, typical telutospore from *Brachypodium sylvaticum*. 5. *P. coronata*, germinating uredospore (*Brachypodium sylvaticum*) 6. *P. Anthistiriæ*, telutospore. 7. *P. Arundinellæ*, on *A. setosa*, germinating telutospore. 8. *P. Arundinellæ*, typical telutospore. 9. *P. Chrysopogi*, germinating telutospore, with abnormally long sterile sterigmata from upper promycelium; b, germinating sporidium. 10. *P. Chrysopogi*, germinating sporidium. 11. *P. Cirsææ*, telutospore. 12. *P. coronata*, from *Agrostis Hookeriana*. 13. *P. Andropogi*, telutospore. 14. *P. Fragariæ*, telutospore.

N. B.—Unless otherwise specified all figures are  $\times 350$ .

\* J. A. S. B. vol. lvi, pt. ii, no. 3, 1897.

XIII.—Definitions of three new Homoptera.—By M. L. LETHIERRY.  
Communicated by E. T. ATKINSON, B. A.

[Received Feb. 28th ;—Read April 3rd, 1889.]

The following descriptions refer to the small homopterons found in such abundance on the mango tree in the early part of the year and indeed up to the rains. Some account of these insects has been given in 'Indian Museum Notes,' Vol I, No. 1; and their life-history is now being investigated.

IDIOCERUS NIVEOSPARSUS.

*Flavescens, fusco et albo-variegatus: vertice subtilissime aciculato-strigoso, medio infuscato, vertice utrinque puncto minutissimo nigro: fronte subtilissime aciculato-strigosa, flava; clypeo flavo, macula basali nigra: pronoto flavo, fusco-irrorato: scutello basi utrinque macula triangulari, medioque vitta angusta usque ad medium continuata, ibique punctis duobus minutis, nigris; summo apice albo: tegminibus nitidis, griseo-flavis, subpellucidis, venis fuscis, fascia subbasali interrupta alba, maculaque parva irregulari ad apicem corii alba; lateribus maculis duabus, una media, oblonga, altera apicali, nigris, spatio insigni albo-hyalino interruptis: corpore cum pedibus subtus fusco-variegato, unguiculis nigris.*—Long. 4 millim. ♂, ♀. I. notato, Fabr., affinis: maculis lateralibus nigris et spatio laterali hyalino tegminum distinctus.

HAB. Saharanpur, Calcutta.

IDIOCERUS ATKINSONI.

*Elongatus, flavescens: vertice medio infuscato, puncto basali, punctoque laterali medio utrinque distinctissimo, nigris, ornato: fronte flava: clypeo flavo linea media longitudinali parva nigra, strigisque lateralibus minutissimis fuscis: pronoto flavo, linea longitudinali angusta media fusca, punctisque duabus anticis nigris: scutello basi utrinque macula triangulari nigra, medioque vitta angusta antice et postice dilatata, fusca, punctisque duobus fuscis: tegminibus subpellucidis, venis fuscis, immaculatis: corpore subtus cum pedibus flavo, unguiculis fuscis.*—Long. 5 millim. ♂, ♀.

HAB. Calcutta, Baliganj.

IDIOCERUS CLYPEALIS.

*Minor, flavescens: vertice flavo, aut immaculato, aut punctis duobus lateralibus (uno utrinque) nigris ornato: fronte flava, aut immaculata,*

1889.]

## L. Lethierry—Definitions of three new Homoptera.

255

ant punctis duobus mediis nigris ornata: clypeo flavo, in medio semper  
vitta angusta nigra, ad basim latiori, ornato: pronoto flavo, immaculato:  
scutello flavo, basi utrinque macula obtuse triangulari nigra ornato:  
tegminibus flavis, nitidis, venis concoloribus, vena costali dilutius flava,  
intus in medio nigro angustissime cincta: corpore subtus flavo, macula  
lateralis sat magna prosterni nigra: pedibus cum unguiculis flavis. Long.  
 $3\frac{1}{2}$  millim. ♂, ♀. Species pictura clypei insignis.

HAB. Calcutta.

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XIV.—*Notice of a Neolithic Celt from Jashpur in the Chota Nagpur District.*—By J. WOOD-MASON, *Superintendent of the Indian Museum, and Professor of Comparative Anatomy in the Medical College of Bengal, Calcutta.*

(With Plate XV.)

An interesting stone implement of Neolithic age has recently been found, in lat.  $22^{\circ} 58' N.$ , long.  $83^{\circ} 41' E.$ , about one mile to the east of Bagicha, a village of the Tappa Kakea zemindary in the Jashpur State situated 30 miles W. N. W. of Jashpur and 31 miles E. S. E. of Bishrampur, in the Chota Nagpur District; it was obtained by the zemindar himself, who very kindly gave it up to Lálá Hirá Lál, an assistant in the Geological Survey of India, by whom it has been presented to the Indian Museum.

When received by me it was still covered with the red clayey earth of the spot in which it had been found.

It is a rather narrow double-edged celt with one face nearly level longitudinally and but slightly convex transversely, the other face longitudinally rather more strongly arched than the broader of the cutting edges, and the two sides plane; and when viewed from either side somewhat resemble a strung bow in outline.

It measures 163 mm. in extreme length, by 41·25 in breadth at the broader cutting edge, which is regularly arched, and 25·75 at the narrower cutting edge, which is irregularly arched, by 25·0 in extreme thickness in the middle; so that it is just about four times as long as it is broad at the broader cutting edge, whence it gradually tapers to its narrower cutting edge, which is equal in breadth to the extreme thickness of the stone.

It is weathered to a pale clay-brown colour.

The rock of which it is made appears to be a trap.

The accompanying plate renders a more detailed description unnecessary.

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# JOURNAL

OF THE

## ASIATIC SOCIETY OF BENGAL.



### Part II.—NATURAL SCIENCE.

No. III.—1889.

XV.—*Noviciæ Indicæ*. I. *Some additional Species of Pedicularis.*

By D. PRAIN. Communicated by DR. G. KING, F. R. S.

[Received Jan. 18th ;—Read Feb. 6th, 1889.]

The account of the genus *Pedicularis*, Linn., in the *Flora of British India*, vol. iv, pp. 306-317, was issued in January 1884 and since then Dr. King's Himalayan collectors have contributed several new forms. The details of a critical examination of the Indian material of this genus preserved at Calcutta, and also of that at Saharanpur, kindly lent for study by Mr. Duthie, are about to appear in another place; meanwhile, diagnoses of the forms new to India, arranged according to the method of the *Flora*, may prove of interest. The numbers of the inner serial list are those of the *Flora*; the references opposite are to descriptions and figures published between 1884 and 1889.

SERIES I. Cauline leaves whorled or opposite.

\* *Upper lip beaked.*

1. (1). *P. PECTINATA* Wall.

a. VAR. *typica*; leaves pinnatipartite segments pinnatifid, calyx teeth triangular acute. Wall., Cat. 420; Maxim., Mel Biol. xii, 810, t. 2, f. 25.

β. VAR. *palans*; leaves pinnatisect segments pinnatipartite, calyx

teeth ovate acuminate. *P. pectinata* Wall. var. *pyramidata* Hook. f., Flor. Brit. Ind. iv, 306 (syn. *P. pyramidata* exclus.). *P. pyramidata* Herb. Ind. or. H f. & T. T. (nec Royle).

The habit of this species and that of *P. pyramidata* vary equally; apparently intermediate forms prove on dissection to be either *P. pectinata* var. *palans* or *P. pyramidata* with much incised leaves. The geographical limits are distinct in the outer Himalayan ranges and hardly overlap in the inner. There is not at Saharanpur or at Calcutta an example of either variety of *P. pectinata* from Kashmir or from Afghanistan, where *P. pyramidata* seems to be the representing form. The diagnosis is as follows:—*P. pectinata*;—beak of corolla gradually tapering to middle then slender, tube sacculate in front at staminal insertion hardly exceeding calyx, lower half of galea erect, stamens inserted opposite top of ovary, filaments densely pilose at insertion as well as above: *P. pyramidata*;—beak of corolla slender from base, tube narrow straight half exceeding calyx, lower part of galea inclined forwards, stamens inserted above middle of tube, filaments glabrous at insertion, slightly hairy above.

## 2. [1]. *P. PYRAMIDATA* Royle.

Stem tall stout 3-4-fariously-hairy, cauline leaves petioled whorled lanceolate pinnatisect or-partite, segments 2-pinnatifid, calyx teeth ovate acuminate entire, corolla tube half exceeding calyx, lip 3-fid obcordate substipitate central lobe small, beak long slender narrowed from base, stamens inserted above middle of tube glabrous at insertion sparingly hirsute above. *P. pyramidata* Royle, Benth. Scroph. Ind, 52; Lindley, Bot. Reg. n. s. xiv, Pl. Misc, 155; Benth., DC. Prodr. x, 565; Maxim., Mel. Biol. xii, 810, t. 2, f. 27.

WESTERN HIMALAYA: Lahul, (Hay! Brandis!); Kashmir, (Royle! Sedgwick!); Gilgit, (Biddulph! Tanner! Giles!); Afghanistan, (Collett! Aitchison!).

Stems 30-80 cm., Spikes 10-30 cm., rootstock stout, leaves 3-4-nately whorled, calyx 10 mm. glabrous or hirsute, corolla purple, tube 13-16 mm. hood inflated rectangularly curved, beak 14 mm. apex entire, ovary ovoid, stigma exserted, capsule 9-11 mm. hardly exserted ovate acuminate, seeds 3.25 mm. pale deeply furrowed and reticulated.

3. (3). *P. TENUIROSTRIS* Benth.; Maxim., Mel. Biol. xii, 811, t. 2, f. 26.

Add to description of F. B. I., iv, 307:—capsule ovate 10 mm. hardly exserted, seeds 3 mm. pale deeply furrowed and reticulated. Fruiting specimens (Duthie 1873!) have now been obtained; the type of this distribution preserved at Saharanpur still retains corollas.

4. (—). *P. OLIVERIANA* Prain.

Tall slender glabrous, leaves 4-nately whorled petioled ovate acute pinnatisect, segments lanceolate pinnatifid, spike interrupted, bracts lanceolate pinnatifid serrate, calyx campanulate, corolla tube slightly exceeding calyx, lip 3-lobed obcordate lateral lobes ovate twice as large as central orbicular, galea angularly curved deflexed beak long flexuous, stamens inserted in middle of tube filaments glabrous. *P. Oliveriana* Prain in Ann. Roy. Bot. Garden, Calcutta, iii ined.

EASTERN HIMALAYA: Phari, (Dr. King's collectors!).

Roots not collected, portions of stem gathered 20-30 cm., calyx 5-6 mm. 5-toothed teeth lanceolate acute serrate equal, corolla purple tube 7 mm. beak 10 mm., ovary ovate acuminate, stigma exserted; capsule not seen.

Repeats habit and foliage of *P. semitorta* Maxim.; diagnosed by the narrow simple bracts, the uncleft calyx and the edentulous throat.

5. (4). *P. GRACILIS* Wall.; Hook. f.

6. (5). *P. PORRECTA* Wall.

7. (6). *P. BREVIFOLIA* Don.

8. (—). *P. INSTAR* Prain.

Glabrescent stems short or tall slender, cauline leaves few paired or whorled distant short ovate oblong or lanceolate pinnatifid pubescent segments crenate, spikes elongated interrupted, bracts foliaceous, calyx campanulate, corolla tube half exceeding calyx, lip 3-partite lobes obovate subequal, galea angularly bent beak narrow slightly decurved tip acute entire, stamens inserted above middle of tube filaments glabrous.

a. VAR. *typica*; stems solitary tall simple strict, radical leaves evanescent petioled cauline 4-nately whorled sessile ovate oblong, beak shorter than lip, capsule broadly ovate  $\frac{1}{3}$  exserted. *P. instar* Prain; Maxim., Mel. Biol. xii, 815, t. 2, f. 32.

EASTERN HIMALAYA: Ong-la-thang and Pey-kiong-la, 13,000 feet, (Dr. King's collectors!).

$\beta$ . VAR. *paradoxa*; stems single or many from base simple or branched dwarf erect or ascending, radical leaves densely tufted cauline opposite or 3-nately (rarely 4-nately) whorled all linear lanceolate petioled, beak as long as lip, capsule lanceolate acute  $\frac{1}{2}$  exserted.

EASTERN HIMALAYA: Nisapokri and Bijan, 11-12,000 feet, (Dr. King's collectors!).

Stems of type 30-60 cm., of var. *paradoxa* 3-8 cm., calyx 4-6 cm. 5-toothed not cleft upper tooth deltoid entire lateral ovate or lanceolate serrate corolla dark red tube 6-8 mm. beak of type 4 mm. of var. *paradoxa* 6 mm., filaments inserted midway between top of ovary and mouth of tube, ovary ovate mucronate apex oblique, stigma exserted, capsule of type 8 mm. of var. *paradoxa* 10-11 mm., seeds 1.5 mm. pale distinctly reticulated.



VAR. *typica* repeats habit, foliage, calyx and capsule of *P. denudata*, VAR. *paradoxa* those of *P. polygaloides*, two species that differ as widely in appearance as do the two varieties of *P. instar*. In these however a diagnosis may be effected by means of the stamens,—glabrous in *P. polygaloides*, hirsute in *P. denudata*; in *P. instar* VAR. *typica* the filaments are glabrous as they are in VAR. *paradoxa* and the forms are not separable as species.

9. [6]. *P. CONFERTIFLORA* Prain.

Stems dwarf or elongated usually branching from the base pubescent or villous, leaves oblong pinnatisect segments ovate incised serrate radical petioled densely tufted cauline opposite one or more paired subsessile, bracts laciniolate segments 3-7 crested at tips, flowers subcapitate or with lowest pair or whorl shortly removed, calyx campanulate, corolla tube twice as long as calyx, lip 3-fid lateral lobes broadly ovate much wider than rounded central, galea angularly curved beak very long narrow slightly decurved apex obtuse entire slightly recurved, stamens inserted in middle of tube filaments glabrous. *P. confertiflora* Prain in Ann. Roy. Bot. Garden, Calcutta, iii ined. *P. brevifolia* Herb. Ind. or. H. f. and T. T. (nec. Don).

EASTERN HIMALAYA: Sikkim, (Hooker!); Chumbi and Phari, (Dr. King's collectors!).

Roots slender stems 6-15 cm. erect simple or many from base central erect the others ascending or decumbent, calyx 6-7 mm. 5-toothed teeth long narrow lanceolate upper entire the rest with entire bases and serrate tips, corolla pink or white tube 11 mm. lateral lobes of lip nearly meeting behind galea, beak 10 mm., ovary ovate apex mucronate, stigma exserted, capsule 10 mm ovate lanceolate apex oblique  $\frac{1}{2}$  exserted, seeds 1.25 mm. ovoid tawny distinctly reticulated.

• Capsule and seeds resemble those of *P. instar* and *P. brevifolia*. Differs from both as to calyx and bracts; *P. instar* VAR. *paradoxa* is at once separable by its deeply 3-partite lower lip, *P. brevifolia* by its emarginate apex of beak.

10. (—). *P. HEYDEI* Prain.

Stems villous ascending simple, leaves densely pubescent lanceolate acute pinnatifid segments acute serrate radical long petioled tufted cauline 3-paired lower shortly petioled upper sessile, bracts foliar sessile, flowers few subspiculate pedicels almost equalling calyx, calyx oblong villous, corolla tube  $\frac{1}{2}$  longer than calyx, lip small sinuately 3-lobed lobes semi-rotund equal margin eroso-crenulate, galea angularly curved beak long falcate apex acute entire, stamens inserted above middle of tube filaments glabrous. *P. Heydei* Prain in Ann. Roy. Bot. Garden, Calcutta, iii ined.

WESTERN HIMALAYA: Lahul; (Watt !); Pangl, (Heyde !).

Roots tufted fusiform fleshy, stems numerous slender, calyx 8 mm. 5-toothed teeth lanceolate subequal upper entire the rest serrate, corolla dark red tube 12-14 mm., beak 8 mm. twice as long as lip, ovary ovate acuminate, stigma exserted, capsule ovate 11 mm.  $\frac{1}{2}$  exserted straight acuminate.

The villous habit of this species recalls *P. brevifolia* Don, with which some gatherings of it have been placed. The straight capsule, entire apex of beak, high staminal insertion, long corolla tube, and tufted fleshy roots indicate a closer alliance to *P. porrecta* than to *P. brevifolia*; its lanceolate leaves, however, at once distinguish it, and the calyx is quite different from that of *P. porrecta*, while the very small scarcely lobed lip removes it equally from both.

11. (7). *P. FLEXUOSA* Hook. f.; Maxim., Mel. Biol. xii, 810, t. 2, f. 35.

12. (—). *P. CHUMBICA* Prain.

Dwarf stems simple slender glabrous tufted, leaves ovate oblong obtuse pinnatisect segments ovate serrate-dentate long petioled radical densely caespitose cauline opposite 1-paired or 0, bracts foliar shortly petioled, flowers few subcapitate pedicels short, calyx campanulate shortly cleft, corolla tube thrice as long as calyx, lip 3-sect lobes rotund subequal, galea angularly curved throat 2-sinuate beak long straight slender apex acute entire, stamens inserted below middle of tube filaments glabrous. *P. chumbica* Prain in Ann. Roy. Bot. Garden, Calcutta, iii ined.

EASTERN HIMALAYA: Chumbi, 11-12,000 feet, at Za-ne-gang and Put-lo, (Dr. King's collectors!).

Roots fibrous slender, stems 4-7 cm., calyx 5 mm. 5-toothed upper tooth entire subulate the others lanceolate serrate, corolla pink or purple tube 14-17 mm, beak 8 mm., anterior filaments inserted at middle of tube posterior opposite top of ovary, stigma exserted, capsule 11 mm.  $\frac{1}{2}$  exserted ovate lanceolate apex straight acute, seeds 1.25 mm. few ovate dark minutely reticulated.

In habit resembles *P. confertiflora* but with a much longer tube and with altogether different capsule and seeds that ally it to *P. flexuosa*.

13. (—). *P. TENUICAILIS* Prain.

Stems slender decumbent or ascending, leaves long petioled 2-pinnatisect ultimate segments pinnatifid radical caespitose cauline 1-2-paired opposite, bracts foliar, flowers axillary opposite distinctly pedicelled lower remote upper subcapitate, calyx campanulate slightly cleft, corolla tube slightly exceeding calyx, lip 3-fid lobes rotund lateral  $\frac{1}{2}$  exceeding central, galea angularly curved beak straight apex acute entire, stamens inserted in middle of tube anterior filaments hirsute. *P. tenuicaulis* Prain in Ann. Roy. Bot. Garden, Calcutta, iii ined.

EASTERN HIMALAYA: Chumbi, 11,000 feet, at Pan-ka-be-see-mo and Tan-ka-la, (Dr. King's collectors!); E. Nepal, at Pey-kiong-la, (Mr. Pantling's collectors!).

Stems short 8-12 cm. or elongate 20-25 cm. branching from base, calyx 6 mm. 5-toothed teeth entire upper lanceolate acute the others ovate obtuse, corolla pink tube 8 mm., beak 10 mm., ovary ovate lanceolate, stigma exserted, capsule 12 mm. narrowly lanceolate  $\frac{1}{2}$  exserted, seeds 2 mm. acutely ovate minutely reticulated.

Like a slender glabrous-form of *P. flexuosa* from which, however, it is easily distinguished by the nonserrate calyx teeth, the entire apex of beak, and the much shorter corolla tube.

14. (—). *P. GAMMIEANA* Prain.

Stems sparingly branched from base villo-pubescent, cauline leaves 2-3 pairs small shortly petioled ovate oblong obtuse 2-pinnate, bracts sessile pinnatifid, flowers few subcapitate, calyx campanulate shortly pedicelled, corolla tube more than twice as long as calyx, lip 3-lobed lobes depressed rounded lateral twice as large as central, galea arcuate beak straight short deeply emarginate, stamens inserted in middle of tube anterior filaments bearded above. *P. Gammieana* Prain in Ann. Roy. Bot. Garden, Calcutta. iii ined.

EASTERN HIMALAYA: Lang-mang-nang-zo, 10,000 feet, (Pantling!).

Stems in the solitary Calcutta gathering 6-8 cm., roots simple fibrous slender, radical leaves 0 cauline very small 5-8 mm. by 2-4 mm., calyx 7 mm. deeply 5-toothed upper tooth lanceolate entire smaller than the others with narrow entire bases and expanded elliptic acutely serrate tips, corolla purple tube 16 mm., beak 4 mm., ovary ovoid apex acute, stigma exserted.

The corolla differs from that of *P. binaria* Maxim. only in having the lower lip ciliate and the central lobe of lip less depressed but the habit of this Himalayan plant is quite unlike that of Maximowicz' Szetschuan plant.

15. (—). *P. SCHIZORRHYNCHA* Prain.

Dwarf stems tufted slightly pubescent, leaves long petioled oblong lanceolate acute pinnatifid segments lanceolate serrate-dentate radical densely caespitose cauline opposite 1-paired or 0, bracts foliar petioled, flowers few subcapitate pedicels short, calyx tubular slightly cleft nerves pubescent, corolla tube slightly exceeding calyx, lip 3-partite margin ciliate lobes subobovate lateral slightly larger than central, galea arcuate subinflated beak short straight apex truncate bifid segments lacinate, stamens inserted above middle of tube anterior filaments densely hirsute. *P. schizorrhyncha* Prain in Ann. Roy. Bot. Garden, Calcutta, iii ined.

EASTERN HIMALAYA: Chumbi, (Dr. King's collectors!); Sikkim, (Jaffrey!); E. Nepal, (Mr. Pantling's collectors!).

Stems simple slender 4-6 cm. erect, roots fibrous tufted rootstock crowned with narrow scales, calyx 9 mm. 5-toothed teeth triangular subequal margins serrulate, corolla purple tube 10-12 mm., beak 4 mm. lateral segments each 3-fid, ovary ovoid, stigma exserted, capsule 10 mm. ovate apiculate slightly exserted, seeds ovoid trigonous grey distinctly reticulated.

16. (9). *P. INTEGRIFOLIA* Hook. f.; Maxim., Mel. Biol. xii, t. 2, f. 23.

\* \* Upper lip shortly or not beaked.

17. (—). *P. ALASCHANICA* Maxim.

Stems stout branching from the base villous ascending, leaves 2-4-nately whorled petioled pinnatifid segments lanceolate decurrent serrate, lower bracts foliar upper with bases entire membranous tips foliaceous pinnatilobed or serrate, flowers sessile in interrupted spikes, calyx membranous inflated ovoid, corolla tube hardly as long as calyx, lip 3-fid lobes rotund lateral thrice as wide as central, galea inflated angularly curved beak conical apex truncate entire, stamens inserted opposite top of ovary anterior filaments bearded.

VAR. *typica*; whorls 4-leaved, calyx nerves and margin villous teeth serrate except upper, beak as long as galea. *P. alaschanica* Maxim., Mel. Biol. x, 91 and xii, 860, t. 5, f. 86, a.

EASTERN HIMALAYA: Chumbi and Phari, (Dr. King's collector!).

VAR. *tibetica*; stems short, leaves opposite, calyx densely pubescent teeth entire, beak distinctly shorter than galea. *P. alaschanica* VAR. *tibetica* Maxim., Mel. Biol. xii, 860, t. 5, f. 86, b.

EASTERN HIMALAYA: Phari, (Dr. King's collector!).

Stems of *type* 15-20 cm., of VAR. *tibetica* 5-8 cm., calyx 12 mm. 5-toothed teeth triangular subequal, corolla yellow tube 11 mm., beak in *type* 2-2.25 mm. in VAR. *tibetica* 1-1.5 mm., ovary ovoid, stigma exserted, capsule ovoid 11 mm. not exserted, seeds large 3 mm. pale deeply furrowed and reticulated.

DISTRIB. S. Mongolia; W. China.

18. (9). *P. GLOBIFERA* Hook. f.; Maxim., Mel. Biol. xii, 869, t. 5, f. 95.

19. (10). *P. CHEILANTHIFOLIA* Schrenk; Maxim., Mel. Biol. xii, 869.

20. (11). *P. ROYLEI* Maxim., Mel. Biol. xi, 288 and xii, 891, t. 4, f. 122. *P. verticillata* Benth., DC. Prodr. x, 563 (pro parte nec Linn.); Hook. f., Flor. Brit. Ind. iv, 309. *P. amœna* Adam. VAR. —; Maxim. Mel. Biol. x, 97.

This Himalayan species repeats the habit and foliage of *P. verticillata* Linn., which is, however, distinct. The diagnosis is as follows:—

*P. Roylei*; bracts pinnatisect or -partite, calyx deeply toothed hardly cleft upper tooth entire the others serrate, corolla tube bent in the middle obtusely, filaments inserted near middle of tube all glabrous anthers ovate acute, capsule ovate acuminate  $\frac{1}{2}$  exserted, seeds 1.25 mm. pale distinctly reticulated: *P. verticillata*; bracts ovate subentire, calyx hardly toothed cleft to the middle margin entire, corolla tube abruptly bent at junction of middle and lower third filaments inserted opposite top of ovary anterior pair hirsute anthers broadly elliptic muticous, capsule lanceolate acute more than  $\frac{1}{2}$  exserted, seeds 2 mm. nigrescent minutely reticulated.

Reichenbach f, (*Icon. Fl. Germ.*, t. 1762, f. 1-14) unfortunately omits the always present hairs from the anterior stamens of *P. verticillata*. Lange (*Bot. Tidskr. Kjob. iv*, t. 2, f. 3) figures the seeds of *P. verticillata*, which differ markedly from those of *P. Roylei*, very exactly.

21. (—). *P. OPHIOCEPHALA* Maxim.

Stems sparsely hirsute erect or ascending simple few leaved, leaves pinnatipartite lanceolate segments oblong subacute incised serrate radical long petioled caespitose cauline short petioled 2-4-nately whorled, calyx campanulate hardly cleft, corolla tube obtusely bent in middle expanded upwards longer than calyx, lip 3-lobed lobes obcordate emarginate lateral  $\frac{1}{2}$  exceeding central, galea slightly curved apex subacuminate, stamens inserted below middle of tube filaments glabrous. *P. ophiocephala* Maxim., *Mel. Biol.* xii, t. 5, f. 94.

NORTH-WEST HIMALAYA: Kamaon, 13-17,000 feet, Ralam Valley, Bidang and Lebang, (Duthie !); W. Nepal, Nampa Gadh, (Reid !).

Rootstock slender or stout crowned with scales, stems 6-15 cm., whorls 3-5-flowered usually approximate, calyx 9 mm. 5-toothed nerves pubescent upper tooth lanceolate or deltoid entire the others subequal serrate, corolla red tube 12 mm., staminal insertion a little above top of ovary, ovary ovoid disc anteriorly thickened, stigma exserted.

22. (12). *P. DENUDATA* Hook. f.; Maxim., *Mel. Biol.* xii, 867.

23. (35). *P. POLYGALOIDES* Hook. f.; Maxim., *Mel. Biol.* xii, 881, t. 5, f. 113.

This species, which has opposite leaves and repeats the habit and foliage of *P. instar* VAR. *paradoxa*, bears the same relationship to *P. denudata* which that variety bears to *P. instar* VAR. *typica*, except that the stamens of *P. polygaloides* are all glabrous those of *P. denudata* all hirsute.

24. (—). *P. GIBBERA* Prain.

Dwarf branched from the base stems prostrate 2-fariously hairy, leaves few radical evanescent cauline opposite distant ovate pinnatipartite segments pinnatifid petioles very long, bracts foliar, flowers

racemose distinctly pedicelled, calyx campanulate slightly cleft, corolla tube  $\frac{1}{2}$  longer than calyx bent forward and expanded at top, lip 3-lobed lobes rounded emarginate equal, galea straight erect apex acuminate, stamens inserted in middle of tube anterior filaments hirsute. *P. gibbera* Prain in Ann. Roy. Bot. Garden, Calcutta, iii ined.

EASTERN HIMALAYA: East Nepal, 13-14,000 feet, at Tha-moo-tsa, Esan-an-gi, Pey-kiong-la and Bijan, (Dr. King's collectors!).

Annual, roots slender, stems 2-15 cm. simple or once branched, racemes few flowered pedicels as long as calyx, calyx 4.5 mm. 5-toothed with crisp white hairs on nerves upper tooth minute the rest lanceolate with obtuse serrate apices, corolla rose-pink or white tube 6 mm. expanded at top, galea twice as wide as tube, ovary lanceolate, stigma subincluded, capsule lanceolate acute 9 mm.  $\frac{1}{2}$  exserted, seeds few (4-6) 3 mm relatively very large black hardly pitted.

Closely related to *P. pygmaea* Maxim. This, however, differs as to bracts, in the corolla tube being bent at the top and not in the middle, in the galea being erostrate, and in the anterior filaments being hirsute. The lanceolate capsule, the very large hardly pitted dark seeds, and the leaves seem to indicate considerable affinity with *P. flexuosa* and its allies.

25. (13). *P. mollis* Wall.; Maxim., Mel. Biol. xii, t. 4, f. 126.

26. (—). *P. fragilis* Prain.

Stems simple elongated sparingly hairy, leaves 3-pately whorled sessile membranous elliptic acute pinnatifid segments lanceolate mucronate serrate, flowers axillary pedicels very short, calyx wide campanulate, corolla externally puberulous tube straight cylindric twice as long as calyx, lip sub-quadrate 2-plicate above anteriorly 3-lobed lateral lobes narrowly ovate acute half as wide as central obovate cucullate projecting, galea slightly dilated straight with very short wide truncate beak, stamens inserted near base of tube anterior filaments hirsute near apex. *P. fragilis* Prain; Maxim., Mel. Biol. xii, t. 5, f. 83. *Pedicularis*, sp. C. B. Clarke, Jour. Linn. Soc. xxv, 51.

ASSAM: Khasia Hills, 5-6000 feet, (Maun!); Barèl Mts, 6-8000 feet, (Prain!). N. Manipur, 6500 feet, (Clarke, n. 42044).

Stems 15-30 cm. lower third decumbent nodes aphyllous bulbiferous above rooting below upper two thirds erect leafy, roots slender disc-bearing, flowers in axils of 3-7 topmost whorls, calyx 5 mm. not cleft teeth 5 narrowly linear lanceolate equal upper entire the others subserrate, corolla green tube 9 mm., lip marginally ciliate, beak 1.5 mm., ovary ovate acuminate, stigma included, capsule 5 mm. subglobose acuminate not exserted; seeds small 1 mm. spherical pale with dark lateral raphe distinctly reticulated.

A very distinct species semi-saprophytic in humid shady forests of the Assam range, in which parasitism was carefully looked for but could not be detected. Attachment of roots to decaying vegetable matter was made out in the field in the specimens obtained in the Barèl range.

27. (—). *P. KINGII* Prain.

Stems elongate very slender flexuose branching sparingly hairy, leaves opposite long petioled ovate pinnatisect segments subalternate 2-pinnatifid, flowers pedicelled racemose axillary, calyx campanulate deeply cleft, corolla straight tube wide cylindric twice as long as calyx, lip subquadrate 2-plicate above 3-lobed in front lateral lobes ovate acute half as wide as central rounded concave, galea slightly bent forward rounded in front apex cucullate, stamens inserted near base of tube anterior filaments distinctly bearded above. *P. Kingii* Prain; Maxim., Mel. Biol. xii, 895, t. 4, f. 127.

EASTERN HIMALAYA: Sikkim, at Gang-tuk, (Dr. King's collectors!).

Rhizome slender crowned with few stoloniferous scales, stolons very slender 5-15 cm. with scales at tips, leaf segments nearer stem distinctly petioluled, flowers in leaf axils towards points of stem and branches, calyx 4 mm. membranous cleft to base anteriorly teeth 5 small entire deltoid upper very minute, corolla tube 8.5 mm., anther lobes acutely tailed tips exserted, ovary ovate disc slightly thickened anteriorly, stigma subexserted; capsule not seen.

A very distinct and remarkable species.

28. (14). *P. PYCNANTHA* Boiss.; Hook. f., Flor. Brit. Ind. iv, 310 (syn. *P. Alberti* exclus.).

VAR. *typica*; bracts subentire, lip distinctly shorter than galea lobes rounded, stamens inserted just below middle of tube. *P. pycnantha* Boiss., Diagn., ser. i, xii, 45 and Flor. orient. iv, 484; Maxim., Mel. Biol. xi, 291 and xii, 895, t. 4, f. 127. *P. Olga* Regel, Acta Hort. Petrop. vi, 348 and Plant. Fedsch., 61. *Pedicularis*, sp. Aitchison, Trans. Linn. Soc. n. s. iii, 9.

WESTERN HIMALAYA: Gilgit, 9-10,000 feet, (Giles!); Afghanistan, Kuram valley, (Aitchison!). DISTRIB.: Northern Persia, Western Turkestan.

VAR. *Semenowi*; bracts serrate, lip nearly equalling galea lobes shortly emarginate, stamens inserted opposite top of ovary. *P. Semenowi* Regel, Bull. Soc. Imp. Mosc. xli, 108 and Plant. Semenow., n. 810; Maxim., Mel. Biol. xi, 294 and xii, 894, t. 4, f. 129. *P. orthantha* Griseb. VAR. —; Maxim., Mel. Biol. x, 129.

WESTERN HIMALAYA: Rantak-chu, (Falconer!); Kunawar, (Royle!); Astor, 13,000 feet, (Tanner!); Lahul, (Hay! Stoliczka! Watt!); Pangl,

11—16,500 feet, and Upper Sntlej, 17000 feet, (Heyde!); Hazara, (Stewart); Gilgit, (Giles!). DISTRIB.: Eastern Turkestan, Altyn and Alatau Mts.

*P. Alberti* has alternate, not opposite, leaves; its stamens too are all glabrous while the anterior pair in this species have hirsute filaments: though the leaves of *P. Alberti* much resemble those of *P. pycnantha* its centrifugal inflorescence allies it more closely to *P. Oederi* which also has alternate leaves.

29. (—).° *P. LYRATA* Prain.

Dwarf, simple or many headed, pubescent, leaves opposite subcordate ovate obtuse widely crenate denticulate petioled, bracts foliar, flowers subracemose shortly pedicelled, calyx tubular hirsute pubescent, corolla tube straight  $\frac{1}{2}$  exceeding calyx, lip 3-lobed 2-plicate above lobes rotund eroso-crenulate subequal central emarginate, galea curved apex angularly cucullate prolonged shortly downwards then bifid with segments lacinate, stamens inserted near base of tube filaments glabrous. *P. lyrata* Prain; Maxim., Mel. Biol. xii, 890, t. 4, f. 135.

EASTERN HYMALAYA: Phari and Ting, (Dr. King's collector!).

Stems 3-6 cm., root slender branching, petioles of radical leaves as long as blade of cauline short, bracts sessile, calyx 8 mm. deeply 5-toothed hardly cleft upper tooth subulate the others with short narrow entire base and elliptic serrate-dentate lamina, corolla white tube 12 mm. slightly widened above glandular ciliate within, galea teeth 3-fid lowest segment subulate longer than the other two triangular, ovary lanceolate disc thickened in front, stigma included, capsule 14 mm. oblong-lanceolate acute nearly half exserted, seeds small 1.5 mm. ovoid rufous distinctly reticulated.

*P. lutescens* Franchet, to which this species is most nearly allied, differs by its shorter corolla tube, its 5-fid galea teeth, and its disc prolonged anteriorly into a spur.

30. (—). *P. COMPTONIAEFOLIA* Franchet.

Stems tall erect puberulous terete strict simple or sparingly branched above, leaves coriaceous shortly petioled 4-nately whorled linear oblong acuminate pinnatifid segments rounded margins cartilaginous minutely toothed, flowers short pedicelled numerous in interrupted spikes, bracts foliar mucronate-serrate longer than campanulate membranous calyx, corolla tube bent obtusely below middle expanded above three times as long as calyx, lip stipitate broadly ovate 2-plicate above shortly 3-fid lobes crenulate central rounded prominent smaller than ovate lateral, galea erect straight shortly beaked apex obliquely truncate with lateral subulate teeth below, stamens inserted opposite top of ovary filaments all pilose at insertion anterior pair hirsute above. *P. comptoniaefolia* Franchet; Maxim., Mel. Biol. xii, 871 t. 5, f. 96.



BURMA: Shan Hills, Fort Stedman, 6000 feet, (Collett!). DISTRIB.: Yunnan.

Stems 80-100 cm. thicker than crowquill, roots not seen, spikes 8-12 cm., calyx not cleft 6 mm. irregularly 5-toothed glabrous teeth deltoid unequal entire margins villous, corolla dark red tube 14-16 mm. obtusely bent at top of calyx internally glandularly hairy, ovary ovate, stigma exserted, capsule 7.5 mm. ovate acuminate slightly exserted, seeds 2.5 mm. testa rufous distinctly reticulated.

31. (—). *P. REX* Clarke.

Stems tall erect glabrous simple or sparingly fastigiate branching above strict 4-angled or slightly 4-winged, radical leaves evanescent cauline petioled 4-nately whorled whorls alternate lower petioles dilated at base upper winged connate in a campanulate perfoliate sheath laminae elliptic pinnatisect rhachis winged segments lanceolate acute pinnatifid, bracts foliar connate at bases in membranous tubes longer than calyx, flowers laxly interruptedly spiked, calyx subsessile thinly membranous deeply cleft and bifid, corolla tube straight 2-3 times as long as calyx, lip stipitate strongly 2-plicate 3-lobed lateral lobes sub-rotund half the size of central cucullate projecting elliptic broader than long, galea curved hardly beaked bidentate below apex, stamens inserted opposite top of ovary filaments rufous-villous above. *P. rex* Clarke; Maxim., Mel. Biol., xii. 875, t. 5, f. 103.

ASSAM: Khasia Hills, (Mann! Clarke). BURMA: (Brandis!). DISTRIB: Yunnan; Kwei-tschou.

Stems 40-120 cm. roots fusiform, spikes 8-30 cm. in 4-flowered whorls 20-30 mm. apart, bract sheaths 10-12 mm. deep, calyx 10 mm. cleft to base below and  $\frac{1}{3}$ - $\frac{1}{2}$  above segments deltoid entire or minutely 2 or 3-toothed at apex, corolla yellow tube 24-30 mm. 2-plicate like lip glandularly ciliate within, galea teeth long subulate, ovary ovate disc prolonged anteriorly as an erect conical spur equalling ovary, stigma included, capsule rhomboid hardly exserted from bract sheath, seeds 3 mm. elliptic black minutely reticulated.

Most nearly allied to *P. superba* Franchet, where also the flowers are sheathed by connivent bracts, but which has a very different calyx and corolla.

32. (—). *P. COLLATA* Prain.

Dwarf stems slender 2-fariously hairy single or tufted, leaves long-petioled radical caespitose cauline 1-pair opposite or 0 oblong acute pinnatipartite segments ovate pinnatifid serrate, bracts foliar 2-pairs opposite, flowers 3 or 4, pedicelled, calyx oblong glabrous, corolla tube wide cylindric straight almost twice as long as calyx, lip 3-lobed 2-plicate lobes large rounded nearly equal, galea straight erect acuminate.

2-dentate below apex, stamens inserted near base of tube anterior filaments bearded above. *P. collata* Prain in Ann. Roy. Bot. Garden, Calcutta, iii ined.

EASTERN HIMALAYA: Chumbi, at Cho-la, (Dr. King's collector!); Eastern Nepal, at Pey-kiong-la and Ny-e-gu, 11-13000 feet, (Mr. Pantling's collectors!).

Stems 1-4 cm., rootstock slender crowned with scales roots tufted fibrous, flowers opposite in both pairs of bracts, or in lower pair only with single terminal flower, calyx 10 mm. 5-toothed upper tooth entire subulate the others ovate obtuse serrate with short narrow entire bases, corolla pink tube 18 mm. dilated above externally lineate-pilose within glandularly hairy, ovary ovate lanceolate disc anteriorly thickened, stigma exserted; capsule not seen.

A very distinct dwarf species with large handsome flowers. The habit repeats that of dwarf forms of *P. Roylei*.

SERIES II.\* Cauline leaves alternate.

\* *Upper lip beaked.*

33. (15). *P. TRICHOGLOSSA* Hook. f.; Maxim., Mel. Biol. xii., 842, t. 3, f. 63.
34. (16). *P. CLARKEI* Hook. f.; Maxim., Mel. Biol. xii., 840, t. 3, f. 60.
35. (17). *P. LACHNOGLOSSA* Hook. f.; Maxim., Mel. Biol. xii., 837, t. 3, f. 55.
36. (18). *P. EXCELSA* Hook. f.; Maxim., Mel. Biol. xii., 828, t. 3, f. 44.
37. (19). *P. MACRANTHA* Klotzsch.

VAR. *typica*; leaves pinnatipartite, flowers rosy red, beak conical gradually narrowing, central lobe of lip as long as lateral lobes. *P. macrantha* Klotzsch in Reis. Pr. Wald., Bot., 108, t. 59; Hook. f., Flor. Brit. Ind., iv, 311.

WESTERN HIMALAYA: Garhwal, (Strachey and Winterbottom,); Kamaon, (Duthie, n. 3216!); Kunawar, (Hoffmeister!).

VAR. *lutescens*; leaves pinnatisect, corolla tube and lip yellow galea and beak dark purple, galea slightly crested beak slender narrow from the base, central lobe of lip shorter than lateral. *P. ochroleuca* Duthie; Maxim., Mel. Biol. xii., 790, t. 1, f. 5, (not of Schlosser).

WESTERN HIMALAYA: Kamaon, 14-15000 feet, in Nipschang Valley; West Nepal, at Nampa Gadh, (Duthie nn. 3219! 5848!).

38. (—). *P. GARCKEANA* Prain.

Slender hirsute stems erect leafy, leaves petioled linear lanceolate pinnatifid segments mucronate dentate, flowers numerous axillary race-

mose long pedicelled, calyx cylindric hirsute distinctly cleft, corolla tube twice exceeding calyx, lip deeply trifold lateral lobes ovate central cuneate truncate projecting, galea falcate not inflated beak slender circinnate apex bifid, stamens inserted below apex of tube filaments hirsute anterior densely posterior sparingly. *P. Garckeana* Prain; Maxim., Mel. Biol. xii, 788.

EASTERN HIMALAYA: Chumbi, Phari, and Jongri, (Dr. King's collectors!).

Stems 5-15 cm. rootstock stout cylindric horizontal branching, pedicels longer than calyx lower pedicels elongating in fruit slender rigid erect 2-3 times as long as capsule, calyx 12 mm. distinctly reticulate-veined within 5-toothed teeth subequal elliptic serrate cristate, corolla dark red tube 22-30 mm. externally pubescent, beak 8 mm. as long as galea tips of apex segments acute, ovary ovate, stigma exserted, capsule ovate acuminate 18 mm.  $\frac{1}{2}$  exserted, seeds 2 mm. rufous ovate subacute above distinctly reticulated.

39. (20). *P. ELWESII* Hook. f.; Maxim., Mel. Biol. xii, 793, t. 1, f. 8.

Add to description of F. B. I. iv, 312:—capsule 15 mm. ovate acuminate  $\frac{1}{2}$  exserted, seeds 2.5 mm. ovate pale distinctly reticulated appendaged below, with dark furrow on one side.

40. (2). *P. ROBUSTA* Hook. f.

41. (—). *P. NEPALENSIS* Prain.

Dwarf glabrous tufted almost stemless, leaves mostly radical all long petioled linear lanceolate pinnatifid segments ovate mucronate-dentate, flowers few (3—5) long pedicelled axillary calyx cylindric with nerves sparingly haired cleft  $\frac{1}{2}$  anteriorly, corolla tube twice as long as calyx, lip 3-lobed margin crenulate lobes truncate lateral ovate twice as large as central rounded, galea inflated reflexed at base then subfalcate with short vertical bifid beak, stamens inserted above middle of tube all filaments hirsute. *P. nepalensis* Prain in Ann. Roy. Bot. Garden, Calcutta, iii ined.

EASTERN HIMALAYA: E. Nepal, at Ka-gling, 13000 feet, (Dr. King's collector!).

Stems 0-1 cm. rhizome short roots tufted fleshy, pedicels 25-35 mm., calyx 15 mm. 5-toothed teeth elliptic serrate upper narrower others subequal, corolla purple tube 25-28 mm. beak 4.5 mm., ovary lanceolate stigma included capsule oblong oblique 20 mm.  $\frac{1}{3}$  exserted, seeds 2 mm. pale broadly ovate reticulations distinct but shallow.

42. (—). *P. SCULLYANA* Prain.

Stems hirsute erect strict stout simple leafy, leaves petioled lanceolate acute pinnatipartite rhachis dentate segments oblong lanceolate

pinnatifid serrate dentate, flowers pedicelled axillary in dense racemes, calyx subglobose inflated hirsute corolla tube hardly as long as calyx, lip 3-lobed lateral lobes ovate twice as large as central orbicular, galea much inflated abruptly bent beak half as long as galea directed downwards deeply bifid, stamens inserted in middle of tube filaments hirsute. *P. Scullyana* Prain; Maxim., Mel. Biol. xii, 789, t. 1, f. 6.

CENTRAL AND EASTERN HIMALAYA:—Nepal, (Wallich! Scully!); Jongri, (Dr. King's collectors!).

Stems 24-50 cm. as thick as little finger, rootstock horizontal thick fleshy, leaves with white crisp hairs, pedicels shorter than calyx, calyx 20 mm. 5-toothed teeth equal ovate lanceolate deeply serrate, corolla yellow tube 18 mm. expanded above externally pilose, beak 4 mm. segments acute, ovary lanceolate stigma exserted, capsule ovate acuminate 23 mm.  $\frac{1}{2}$  exserted, seeds 3 mm. pale appendaged below, reticulations small but deep.

43. (21). *P. MEGALANTHA* Don.

VAR. *typica*; flowers numerous densely racemose, corolla tube 2-3 times as long as calyx, lateral lobes of lip twice as wide as irregularly triangular central. *P. megalantha* Don. Prodr. Flor. Nepal. 94; Wall., Cat. 411; Benth., DC. Prodr. x, 564; Regel, Gartenflora, t. 943; Hook. f., Flor. Brit. Ind. iv, 312. *P. Hoffmeisteri* Klotzsch, Reis. Pr. Wald., Bot., 108, t. 60.

ALPINE HIMALAYA: Kashmir to Chumbi and Bhutan.

VAR. *pauciflora*; flowers few (3-6) axillary; corolla tube 4-5 times as long as calyx, lateral lobes of lip deeply emarginate 4-5 times as wide as subligulate central. *P. megalantha* VAR. *pauciflora* Prain; Maxim., Mel. Biol. xii, 793.

EASTERN HIMALAYA: Chumbi and Jongri, (Dr. King's collectors!).

Corolla tube, of *type* 50-55 mm., of VAR. *pauciflora* 80 mm. Flowers in West Himalaya golden-yellow, in Nepal pink galea with yellow tube and lip, in Sikkim and Bhutan rose-purple, in S Tibet dark purple.

44. (22). *P. BICORNUTA* Klotzsch.

45. [26]. *P. ELEPHANTOIDES* Benth.

Stems pubescent simple stout erect leafy, leaves petioled linear oblong pinnatifid segments obtuse crenate, flowers numerous crowded racemose pedicelled, calyx inflated glabrous, corolla tube hardly exceeding calyx, lip deeply 3-lobed lateral lobes ovate  $\frac{1}{2}$  wider than central oblong, galea slightly inflated beak narrow very long slender flexuous apex reflexed obtuse entire, stamens inserted near apex of tube filaments glabrous. *P. elephantoides* Benth., Scroph. Ind. 53, and DC. Prodr. x, 564; Maxim., Mel. Biol. xii, t. 1, f. 4.

WESTERN HIMALAYA :—Kashmir, (Royle, Sedgwick!).

Stems as thick as goose quill, pedicels half as long as calyx, calyx 15 mm. 5-toothed slightly cleft teeth ovate serrate upper  $\frac{1}{2}$  the size of others densely reticulate between the nerves, corolla yellow, on with galea and beak purple, tube 15 mm.; beak 24 mm. margins of filaments undulate, ovary lanceolate acute, stigma exerted, capsule not seen.

Repeats habit and foliage, calyx, corolla tube and lip of *P. bicornuosa* from which, however, it differs in the throat not being contorted and in the beak, which is nearly twice as long and is quite entire at apex. Apparently uncommon and not reported either at Calcutta or Saharanpur since collected by Dr. Royle till communicated by Major Sedgwick, R. E. in 1885. In Sedgwick's plant the hood and beak are dark purple the tube and lower lip golden yellow.

46. (23). *P. BELLA* Hook. f.; Maxim., *Mol. Biol.* xii. t. 1, f. 3.

47. (—). *P. PRZEWALSKII* Maxim.

Dwarf almost stemless, radical leaves tufted narrowly oblong imbricate-crenate densely pubescent, flowers few axillary pubescent, calyx cylindric slightly cleft, corolla tube almost thrice as long as calyx, lip deeply 3-lobed lobes rounded subequal, galea erect slightly inflated beak straight bifid halfway, stamens inserted near top of tube filaments all hirsute. *P. Przewalskii* Maxim., *Mol. Biol.* x, 84, and xii, 787, t. 1, f. 2.

EASTERN HIMALAYA :—Phari, (Dr. King's collector!). *DISTRIB* : N. Tibet; China, Kansu and Szetschuan.

Rootstock fusiform somewhat slender, calyx densely hirsute 11 mm. 5-toothed upper tooth entire very small the others crested anterior pair smaller than lateral, corolla rose-pink tube 30 mm. puberulous externally, beak 7 mm. segments slightly expanded at tips, ovary oblong, stigma subincluded, capsule oblong oblique shortly cuspidate.

48. (—). *P. DALTONI* Prain.

Densely pubescent stems short erect, leaves petioled linear pinnatifid segments ovate mucronate-dentate flowers axillary pedicels very long, calyx cylindric  $\frac{1}{2}$  cleft anteriorly densely hirsute, corolla tube  $\frac{2}{3}$  exceeding calyx lip 3-fid margin crenulate lobes rounded lateral  $\frac{1}{2}$  larger than central, galea inflated slightly reflexed then arcuately curved beak straight  $\frac{1}{2}$  bifid stamens inserted above middle of tube filaments all hirsute. *P. Daltoni* Prain in *Ann. Roy. Bot. Garden, Calcutta*, iii ined. *P. asplenifolia* var *pubescens* Hook. f., *Flor. Brit. Ind.* iv, 315. *Pedicularis* n. 20, *Herb. Ind. Or. H. f. and T. T.*

EASTERN HIMALAYA : Sikkim, Donkia-la, (Hooker & Dr. King's Collector!), and Ze-lep-la, (Dr. King's Collector!); Chumbi, Perm-la and Chum-la-ree, (Dr. King's Collectors!); Phari, (Dr. King's Collector!).

Stems 2-6 cm. high, 2-20 from stout branching rhizome, petioles slightly dilated at base, pedicels 25-60 mm. rigid elongating in fruit, calyx 10-12 mm. 5-toothed segments elliptic serrate upper smallest, corolla red tube 16 mm. distinctly widened at apex nearly glabrous externally, beak 5 mm. segments with acute tips, capsule oblong oblique shortly cuspidate nearly  $\frac{1}{2}$  exserted, seeds ovoid pale distinctly reticulated.

49. (24). *P. SIPHONANTHA* Don; Hook. f.

VAR. *typica*; leaf segments lanceolate, corolla tube 4-5 times as long as calyx, throat acutely bidentate. *P. siphonantha* Don, Prodr. Flor. Nepal., 95; Wall., Cat. 417; Benth., DC. Prodr. x, 565. *P. Hookeriana* Wall., Cat., 421; Benth., Scroph. Ind. 53, and DC. Prodr. x, 564. *P. himalayca* Klotzsch, Reis. Pr. Wald., Bot., 107, t. 58.

In two very distinct forms:—*a*. "*siphonantha vera*", with short decumbent stems or stemless, leaf segments contiguous = *P. siphonantha* Don; Wall.; Benth. ll. cc., the more usual form in Sikkim and Nepal, comparatively unusual in Kamaon and not apparently occurring in Kashmir or W. Tibet; and *β*. "*Hookeriana*", with long ascending or erect stems, leaf segments distant subalternate = *P. Hookeriana* Wall.; Benth. ll. cc. and = *P. himalayca* Klotzsch l. c., the form characteristic of Kashmir and W. Tibet but occasionally reported from Sikkim also. There are, however, forms intermediate in habit and as the floral structure is identical, they cannot be looked upon as distinct varieties.

VAR. *brevituba*; leaf segments ovate, corolla tube 2-3 times as long as calyx, teeth of throat obtuse or almost absent. *P. Elephas* Boiss., Diag., Ser. i; iv, 81, and Flor. orient., iv, 489; Benth., DC. Prodr. x, 565. *P. punctata* Dene, Jacquem. Voy., Bot., 111, t. 122; Benth., DC. Prodr. x, 565.

Also in two very distinct forms:—*γ*. "*Elephas*", with short stems and contiguous imbricate leaf-segments = *P. Elephas* Boiss. ll. cc. as to description but excluding "Griffith 1060" which has apex of beak entire and is, as Sir J. D. Hooker points out, *P. rhinanthoides*:—and *δ*. "*punctata*" with tall rigid erect stems and distant alternate leaf-segments = *P. punctata* Dene; Benth. ll. cc., frequently distributed with specimens of form *β*. as "*P. Hookeriana*." Specimens intermediate as to foliar characters certainly occur but "*punctata*" differs from Wall. Cat. 421 by its shorter tube, indistinct teeth, and very large lower lip the lateral lobes of which embrace the throat and meet behind the galea; these characters though constant are not however of specific value.

The forms of VAR. *typica* repeat the habit and foliage of the two forms of *P. longiflora*, those of VAR. *brevituba* repeat the habit and foliage of the two varieties of *P. rhinanthoides*.

*P. labellata* Jacquem. is excluded from *P. siphonantha* by its entire apex of beak, its edentulous throat, its inflated galea and its 5-toothed calyx, while *P. Hoffmeisteri* Klotzsch, an original specimen of which Dr. Garcke of Berlin has kindly sent to the Calcutta herbarium, is *P. megalantha* Don, VAR. *typica*.

50. (27). *P. LONGIFLORA* Rudolph, Mem. Acad. St. Petersburg, iv, 345, t. 3, (1811); Bunge, Ledeb. Flor. Ross. iii, 276; Maxim., Mel. Biol. x, 86. *P. tubiflora* Fischer, Mem. Soc. Mosc., iii, 58, (1812); Steven, Monogr. Pedic., 30; Benth., DC. Prodr. x, 565; Hook. f., Flor. Brit. Ind. iv, 314. *P. tubiformis* Klotzsch, Reis. Pr. Wald., Bot. 106, t. 57.

51. (26.) *P. RHINANTHOIDES* Schrenk.

VAR. *typica*; stems short 5-10 cm., beak 6 mm. as long as galea shorter than lip, anterior stamens sparingly hirsute. *P. rhinanthoides* Schrenk, Enum. Pl. Nov., i, 22; Benth., DC. Prodr. x, 565; Bunge, Ledeb. Flor. Ross. iii, 276.

Not in India. DISTRIB: Alatau, (Schrenk); Hindoo Koosh, (Griffith 1060 !); Turkestan, Ishomori, (A. Regel!).

A gathering from Tehri-Garhwal with short stems 3 cm. high, (Duthie 576 !), has the short beak of VAR. *typica* with the stout stems and densely hairy anterior stamens of the following variety which it thus connects with the typical plant.

VAR. *labellata*; stems stouter 8-40 cm., beak 10-14 mm. longer than galea and equalling or exceeding lip, anterior stamens densely hirsute. *P. labellata* Jacquem., Dene, Jacquem. Voy., Bot., 117, t. 123; Benth., DC. Prodr. x, 565; Maxim., Mel. Biol. x, 83, and xii, 792. *P. rhinanthoides* Hook. f., Flor. Brit. Ind. iv, 313, excluding synonyms.

52. (—). *P. GRUINA* Franchet.

Branching from base central stem erect others decumbent stems hirsute leafy, leaves very small short-petioled pinnatipartite segments distant oblong recurved margins cartilaginous serrate, flowers axillary racemose distant long pedicelled, calyx hirsute campanulate, corolla tube slightly exceeding calyx, lip broader than long 3-lobed lateral lobes rhomboid 4 times as large as central orbicular, galea inflated bidentate beak long slender apex decurved acute entire, stamens inserted above middle of tube filaments hirsute. *P. gruina* Franchet; Maxim., Mel. Biol. xii, 799, t. 1, f. 15.

BURMA-YUNNAN FRONTIER: Momyen, (Anderson!). DISTRIB: Yunnan.

Roots slender fibrous, central stem 8-10 cm. sparingly shortly branched, decumbent stems simple rooting below, pedicels longer than calyx, calyx 6 mm. 5-toothed teeth equal ovate acute with narrow entire bases and deeply retroserrate margins above, corolla red tube 7.5 mm., beak 10 mm., ovary oblong lanceolate, stigma hardly exerted.

Momyen, the locality of the single Calcutta gathering, is just within the Yunnan frontier, technically therefore this species does not deserve a place in the Indian Flora; as, however, when Upper Burma becomes botanically better known this is likely to be met with the diagnosis is given here.

53. (25). *P. CARNOSA* Wall.; Maxim., Mel. Biol. xii, t. 3, f. 52.

54. (28). *P. MICROCALYX* Hook. f.; Maxim., Mel. Biol. xii, 852, t. 4, f. 71.

55. [29]. *P. ALBIFLORA* Prain.

Dwarf tufted glabrous stems short or 0, canline leaves 0 radical numerous caespitose long petioled oblong-lanceolate pinnatisect segments distant ovate mucronate-dentate, flowers few shortly pedicelled subcapitate or the lower scattered lower alternate upper subopposite, calyx cylindric-campanulate hardly cleft, corolla tube twice as long as calyx lip 3-lobed lobes rounded lateral  $\frac{1}{2}$  exceeding central galea arcuately curved beak conical falcate apex obtuse crenulate not bifid, stamens inserted in middle of tube filaments glabrous. *P. albiflora* Prain in Ann. Roy. Bot. Garden, Calcutta, iii ined. *P. asplenifolia* var. *albiflora* Hook. f., Flor. Brit. Ind. iv, 315.

EASTERN HIMALAYA; Sikkim, (Hooker, Dr. King's Collectors!).

Stem 0.8 cm., rootstock slender with few ovate scales, bracts  $\frac{1}{2}$  longer than calyx 3-sect dilated at base, calyx 8-10 mm. 5-toothed teeth lanceolate entire obtuse except upper smallest acute, corolla white tube 20-24 mm. uniform throughout beak 3.5 mm., ovary lanceolate stigma subexserted; capsule not seen.

56. (29). *P. WALLICHII* Bunge, Bull. So. Acad. St. Petersb. viii, 251, (name only), and Walp. Rep. iii, 415. *P. asplenifolia*, Wall, Cat. 416A, (not of Floerke and excluding specimen B). *P. asplenifolia*, Hook. f., Flor. Brit. Ind. iv, 315, (not of Floerke, and excluding varieties and synonyms).

This differs from *P. albiflora* in having both pairs of stamens hirsute, in its wide subinflated calyx, its numerous lanceolate rhizome scales and its few radical leaves. Wall. Cat. 416B is *P. Oederi* Vahl, var. *heteroglossa*.

57. (30). *P. FLAGELLARIS* Benth.; Hook. f.

58. (31). *P. FURFURACEA* Wall.; Maxim., Mel. Biol. xii, t. 3, f. 50.

59. [31]. *P. PANTLINGII* Prain.

Stems single or several from base unbranched rigid tall leafy 3-5-fariously hairy above, leaves long-petioled furfuraceous beneath broadly ovate pinnatilobed lobes ovate serrate, flowers axillary in dense racemes pedicelled, calyx campanulate hirsute, corolla tube widened above as long as calyx, lip 3-lobed margin ciliate lateral lobes ovate thrice as



large as central orbicular, galea inflated bent at a right angle beak straight apex bifid segments emarginate, stamens inserted opposite top of ovary anterior filaments puberulous. *P. Pantlingii* Prain in Ann. Roy. Bot. Garden, Calcutta, iii ined. *P. furfuracea* var. *integrifolia* Hook. f., Flor. Brit., Ind. iv, 316. *Pedicularis* n. 30, Herb. Ind. or H. f. and T. T.

EASTERN HIMALAYA: Sikkim, (Hooker, Pantling !); Chumbi, (Dr. King's collectors !).

Rootstock slender, stems as thick as goose quill strict 30-40 cm. calyx 8 mm. nerves densely pilose 5-toothed not cleft teeth large upper deltoid entire others ovate incised serrate, corolla red-purple tube 8 mm., beak 8 mm inner lobe of apex segments larger, capsule 17 mm. broadly lanceolate acuminate  $\frac{1}{2}$  exserted, seeds 2 mm. ovate acute black hardly reticulated.

Very similar and nearly allied to *P. furfuracea* Wall. but with less incised leaves and more rigid thicker stems. The diagnosis is as follows:—*P. furfuracea*; calyx glabrous  $\frac{2}{3}$  cleft in front 5-or 3-toothed teeth minute, or margin not toothed, corolla pale pink or white tube somewhat longer than calyx, lobes of lip all truncate emarginate eciliate, galea glabrous throat 2-sinuate apex of beak deeply bifid segments emarginate outer lobes large ovate, filaments glabrous, capsule narrowly lanceolate acuminate  $\frac{2}{3}$  exserted; *P. Pantlingii*; calyx hirsute not cleft 5-toothed teeth large, corolla dark-purple tube not exserted, lobes of lip rounded entire margin ciliate, galea furfuraceous throat entire apex of beak less deeply bifid segments emarginate outer lobes triangular minute, anterior filaments puberulous, capsule wide lanceolate acuminate  $\frac{1}{2}$  exserted. The flower and fruit in *P. Pantlingii* are larger than in *P. furfuracea*, in which calyx is 6 mm., corolla 10 mm., capsule 14 mm.

60. (—). *P. REGELIANA* Prain.

Dwarf stemless, leaves pinnatisect segments ovate pinnatifid toothed, flowers axillary long pedicelled, calyx campanulate nerves hirsute, corolla tube  $\frac{1}{2}$  longer than calyx expanded above, lip 3-fid lobes rounded lateral  $\frac{1}{2}$  exceeding central, galea much inflated arcuate throat 2-dentate beak very short truncate apex entire, stamens inserted above middle of tube anterior filaments densely posterior sparingly hirsute. *P. Regeliana* Prain in Ann. Roy. Bot. Garden, Calcutta, iii ined.

EASTERN HIMALAYA: Phari and Jongri, (Dr. King's collectors !).

Roots slender fibrous, leaves long-petioled, pedicels stout 2-4 times as long as calyx, calyx 10 mm. 5-toothed  $\frac{1}{2}$  cleft in front teeth serrate upper smallest lateral larger than anterior pair, corolla purple tube 15-18 mm., galea with teeth directed downwards and crested above as far as the origin of beak, beak 1.5 mm., ovary ovate, stigma exserted,

capsule 18 mm, narrowly ovate apex acuminate  $\frac{1}{2}$  exserted, seeds few 2.5 mm. ash grey striate but hardly reticulated.

Repeats habit and foliage of *P. acaulis* Wulff. but is smaller in all its parts. The calyx teeth are smaller and the galea is widely different; the capsule on the other hand is larger.

61. (—). *P. ODONTOPHORA* Prain.

Stems short puberulous several from rootstock, leaves long petioled radical few finally evanescent cauline 1-2 alternate pinnatisect segments pinnatifid, flowers few axillary rather crowded shortly pedicelled, calyx campanulate, corolla tube twice as long as calyx slightly widened above, lip 3-lobed lobes ovate later  $\frac{1}{2}$  exceeding central, galea 2-dentate slightly inflated widely arcuately curved beak straight apex emarginate, stamens inserted in middle of tube anterior filaments densely hirsute throughout posterior sparsely hirsute below glabrous above. *P. odontophora* Prain in Ann. Roy. Bot. Garden, Calcutta, iii ined.

EASTERN HIMALAYA:—Sikkim, Na-tong, (Dr. King's collectors!); Phari, Do-tho, (Dr. King's collector!).

Rootstock creeping with squamous nodes and crowned with scales, stems 2-4 cm. calyx 7 mm. 5-toothed teeth entire upper tooth and lower pair deltoid intervening subulate, corolla tube white 13 mm. with dorsal line of hairs outside extended along erect portion of galea which is bidentate anteriorly, inflated part of galea and beak pink, beak 5 mm., ovary ovoid, stigma exserted; capsule not seen.

A very distinct species.

62. (?32). *P. CURVIPES* Hook. f.; Maxim., Mel. Biol. xii, 919.

Not yet received in flower. Add to locality of F. B. I. iv, 316;—ASSAM: Naga Hills, 9000, (Clarke!).

63. (33). *P. DOLICHORRHIZA* Schrenk, Enum. Pl. Nov. ii, 23; Walp. Rep. iii, 426; Bunge, Ledeb. Flor. Ross. iii, 291; Benth., DC. Prodr. x, 570; Maxim., Mel. Biol. x, 117 and xii, 905, t. 6, f. 146. *P. cabulica* Benth., DC. Prodr. X, 575. *P. fissa* Turcz. ? Hook. f., Flor. Brit. Ind. iv, 316.

WESTERN HIMALAYA: Iskardo, (Dr. Falconer's collectors!); Ladak, (Henderson!); Gilgit, (Tanner!, Giles!); Hindu Koosh, (Griffith, [3941 Kew distribution]!, Giles!); Afghanistan, Kurzar, (Griffith, [1143 Journ.]!).

Gilgit and W. Tibet gatherings quite agree with specimens of *P. dolichorrhiza* received from St. Petersburg; it is not possible to separate *P. cabulica* from *P. dolichorrhiza* even as a variety.

\* \* *Upper lip shortly or not beaked.*

64. (34). *P. OEDERI* Vahl in Hornem., Oekon. Plantel., ed. ii,

580, (1806) and ed. iii, 674; Hartm., Flor. Skand., 199; Caruel in Parlatores, Flor. Ital. vi, 429; Reichb. f., Flor. Germ. xx, 76, t. 1759, f. 2; Lange, Nomenclator Flor. Dan., 2; Trautv., Incr. Flor. Ross. iii, 77. *P. versicolor* Wahlenberg, Veg. Helvet., 118, (1813) and Flor. Suec. i, 389; Hartm., Vet. Ak. Handl., 135; Steven, Monogr. Pedic., 52; Reichb., Iconog. i, 31, t. 14; Ledeb., Flor. Altaic. ii, 437; Turcz., Flor. Baic.-Dahur. iii, 375; Bunge in Ledeb. Flor. Ross. iii, 300; Walp., Rep. iii, 428; Royle, Illustr. t. 72, f. 2; Benth., DC. Prodr. x, 578; Maxim., Mel. Biol. x, 133 and xii, 918, t. 7, f. 177; Hook. f., Flor. Brit. Ind. iv, 316. *P. flammea* Oeder, Flor. Dan., t. 30, (1761); Allioni, Flor. Pedemon. i, 63; Haencke in Jacquin. Collectan. ii, 70; Poiret in Lamk, Encyclop. v, 135; (not *P. flammea* Linn.). *P. flammea* var. *major* Wahlenberg, Flor. Lappon., 168, (1812). *P. hirsuta* Smith in Rees, Cyclop. vol. xxvi, (1819); (not *P. hirsuta* Linn.).

VAR. *typica*; galea wider and shorter than tube, central lobe of lip not projecting, calyx teeth triangular equal apices acute.

WESTERN HIMALAYA:—Kashmir, (Royle!); Tibet, (Falconer!, Thomson!, Stoliczka!, Brandis!, Ellis!). DISTRIB: Arctic and Alpine Europe; Arctic and Alpine Siberia; Arctic America.

The Kashmir and Tibet plant is the same as the Dahurian form having the calyx hirsute and the teeth, except the upper, serrate; the lobes of the lip are entire as in the Scandinavian and Arctic form, (*P. Oederi* Vahl), where the calyx is also hirsute but all the calyx teeth are entire, and not emarginate as in the Swiss plant, (*P. versicolor* Wahlbg, Veg. Helvet. 118), where the calyx teeth are also entire the calyx being glabrous.

VAR. *heteroglossa*; galea narrower than in type and as long as tube, central lobe of lip projecting, calyx teeth narrowly lanceolate all, or upper excepted, with expanded orbicular serrate tips. "*An eadem ac P. asplenifolia?*" Wallich in sched., Wall Cat., 416 B.

WESTERN AND CENTRAL HIMALAYA:—Kamaon, (Royle!, Wallich!, Collett!, Duthie!, Reid!); Nepal, (Scully!). DISTRIB: N. Tibet, N. China, E. Kansu.

The Kamaon form is Wall. Cat. 416B which that author only doubtfully referred to his *P. asplenifolia*. It may be the plant intended by Royle, (Ill., t. 72, f. 2), since he there figures a plant with small lower lip, which is true of this, and since Kamaon specimens of this obtained by him are preserved at Saharanpur. But the lip of his figured plant is too small even for this form and he cites Kashmir in the text as its locality; his Kashmir specimens are true var. *typica* only. The various Kamaon gatherings exactly agree;—calyx hirsute upper tooth linear lanceolate acute, lip of corolla  $\frac{1}{2}$  smaller than in var.

*typica* margin crenulate central lobe ovate lanceolate, gales  $\frac{1}{2}$  longer than in *VAR. typica* as narrow as tube. Dr. Scully's Nepal gathering differs considerably;—calyx glabrescent all the teeth with ovate expanded tips, corolla lip 3 times as large as in *VAR. typica* margin entire lobes orbicular, galea narrower than tube. The greatest difference is in the much larger lip; perhaps *VAR. heteroglossa* should be considered a species distinct from *P. Oederi* with the Nepal plant as a definite variety of this new species.

65. (—)° *P. PRAINIANA* Maxim. .

Erect strict stout hirsute stem leafy simple, leaves oblong linear sessile deeply pinnatifid segments oblong acute deeply irregularly serrate, bracts linear oblong serrulate at apex, flowers densely spiked, calyx campanulate hirsute, corolla tube slightly exceeding calyx, lip 3-fid lobes obovate equal margins ciliate, galea sparsely hairy navicular beakless, stamens inserted in middle of tube filaments glabrous. *P. Prainiana* Maxim., Mel. Biol. xii, 844, t. 3, f. 66.

EASTERN HIMALAYA: Chumbi, at Lu-ma-poo, (Dr. King's collector!).

Stem 30-40 cm., upper bracts shorter than flowers, calyx 16 mm. 5-toothed upper tooth entire deltoid the others lanceolate serrate, corolla yellow tube 17 mm., galea rounded in front hiant, ovary ovoid, stigma exserted; capsule not seen.

Repeats habit and foliage of *P. Clarkei*. Is nearly allied to *P. rudis* Maxim. and was originally distributed from Calcutta under that name; it is, however, as Mr. Maximowicz points out, perfectly distinct.

66. (26). *P. PERROTETII* Benth.; Maxim., Mel. Biol. xii, t. 1. f. 1.

67. (—). *P. CORYMBOSA* Prain.

Stems stoutish short irregularly angular or flattened 2-3 furiously hairy branching, leaves petioled pubescent fleshy oblong acute narrowed at the base crenate lobes serrate, bracts sessile, flowers capitate and very shortly pedicelled at apices of stem and branches, calyx oblong pubescent fleshy, corolla tube twice as long as calyx slightly expanded above, lip 3-fid lobes oblong equal, galea hardly inflated widely arcuately curved and scarcely beaked, stamens inserted opposite top of ovary filaments glabrous. *P. corymbosa* Prain in Ann. Roy. Bot. Garden, Calcutta, iii ined.

BURMA: Shan Hills, Pwehla and Tamakan, 4000 feet, (Collett!); Maymyo Hill, 4000 feet, (Dr. King's collector!).

Stems 10-15 cm., branches axillary subcorymbose, roots fibrous, bracts wide-based serrate crenate  $\frac{1}{2}$  longer than calyx, calyx 11 mm. deeply 2-fid,  $\frac{1}{2}$  cleft in front teeth ovate crested tube densely pubescent externally and reticulated between the nerves within, corolla

tube white 18-24 mm., lip white with pink margin, galea rose-pink, ovary ovate lanceolate, stigma exserted.

Evidently nearly allied to *P. crenata* Maxim. which differs in having smaller flowers (22 mm. in place of 35-38 mm.), calyx not cleft both lobes 2-dentate and not reticulated internally, galea distinctly beaked, lip with ciliate margin, and anterior filaments bearded.

68. (—). *P. COLLETTII* Prain.

Very tall stems purpurascant pubescent terete rigid strict sparingly fastigiate branched towards apex, leaves and bracts coriaceous subscabrid ovate acute sessile crenulate serrate, flowers axillary sessile densely spiked, calyx coriaceous oblong densely pilose deeply 2-fid, corolla tube exceeding calyx expanded above glandular ciliate internally, lip widely stipitate 3-fid lobes orbicular equal, galea externally furfuraceous arcuately curved with short truncate beak emarginate at apex, stamens inserted near base of tube filaments rufous villous at insertion, glabrous above. *P. Collettii* Prain in Ann. Roy. Bot. Garden, Calcutta, iii ined.

BURMA: Shan hills, Koni, 4000 feet, and Toungyi, 5000 feet, (Collett!).

Stems 120 cm., rootstock stout horizontal, bracts longer than calyx, calyx 14 mm.  $\frac{1}{2}$  cleft in front,  $\frac{1}{3}$  behind, segments wide below, lanceolate above, tips obtuse entire, corolla purple tube 16 mm. ovary lanceolate acuminate, stigma exserted.

A very striking species with considerable affinity to *P. zeylanica* but with galea larger in proportion to tube and very different foliage and habit.

69. (37). *P. ZEYLANICA* Benth.; Maxim., Mel. Biol. xii, t. 3, f. 45.

INSUFFICIENTLY REPRESENTED.

70. (—). *PEDICULARIS* sp with alternate leaves.

MANIPUR: Sirohifurar, (Watt!).

In leaf only; certainly not the same as any in the above list; seems a member of the section "SIPHONANTHÆ," and is possibly conspecific with one or other of the Yunnan species of that section.

[Mr. Maximowicz in a letter received since the above was written says of this plant that it "looks like a *Siphonantha* or (less so) a *Comosa*." He does not recognise in it any of the Yunnan species (of which he has given full descriptions in Mel. Biol. xii); it should therefore be a species yet to be described.]

**XVI.—*Natural-History Notes from H. M. Indian Marine Survey Steamer 'Investigator,' Commander ALFRED CARPENTER, R. N., D. S. O., commanding.—No. 10. List of the Pleuronectidæ obtained in the Bay of Bengal in 1888 and 1889, with descriptions of new and rare species.—By ALFRED ALCOCK, M. B. (ABER.), Surgeon-Naturalist to the Marine Survey.***

[Received and Read August 9th, 1889.]

(With Plates XVI.—XVIII.)

CONTENTS.

- § 1. Introduction.
- § 2. List, with Descriptions, of the Shallow-Water Forms obtained during Season 1888-89.
- § 3. List, with Descriptions, of the Shallow-Water Forms obtained during Seasons previous to 1888-89.
- § 4. Descriptions of the Deep-Sea Forms obtained from Commencement of Survey to Date.

§ 1. *Introduction.*

This paper gives merely a list of the *Pleuronectidæ* obtained by the trawl and dredge in the Bay of Bengal during two seasons' work of H. M. I. M. Survey Steamer 'Investigator,' with descriptions of new and rare species. Complete synonymies are not given, mainly because the systematic exploration of the Bay can only be regarded as begun, and it would be premature to catalogue any one group until the whole basin has been more thoroughly explored.

This initial list contains the names of 29 species, of which 11 appear to be new to science, 3 are rare species not before met with in Indian waters, while the remaining 15 are well-known forms.

Again, of these 29 species, 23 are from the Orissa coast and the Ganjam coast north of Gopalpur, 3 are from the deeper open waters of the northern end of the Bay, while 2 are from the east coast of Ceylon, and 1 from Cocanada. These last 6 species are the fruit of occasional dredgings, so that we are left with 23 species representing four months regular trawling off the Orissa coast, or rather off the eastern coast of the peninsula between False Point on the north and Gopalpur on the south—a region nearly corresponding with the debouchement of the Máhánaddi Delta.

The physical features here are those of all Indian deltas where the land is making precarious advances on a shoaling muddy sea. Low-lying wastes of drifting sand alternate with still lower-lying estuarine swamps; the coast line presents the unbroken level of a recently formed

alluvium; the bed of the sea is an almost imperceptible slope of fine sand and mud, and the more or less turbid waters are consequently so shallow that the twenty-fathom line is distant from five to thirteen miles from shore, while the hundred-fathom line ranges from fifteen to twenty-two miles, as was determined by the 'Investigator' in her recent survey. Towards the south the sea deepens, and the bottom becomes more sandy.

The waters of this region swarm with crustaceans and fishes. *Penæidæ*, *Paguridæ*, and all the families of the Brachyura exist in the greatest abundance, while the surface waters are crowded with the lower crustacea and with crustacean larvæ. The commonest fishes are *Sciaena*, *Kurtus*, *Polynemus*, *Equula*, *Arius*, *Pellona*; *Carcharias Scyllium*, *Trygon*; and, among the Pleuronectids, *Pseudorhombus* and *Cynoglossus*.

§ 2. *List, with Descriptions, of the Shallow-Water Fishes obtained (in the above region) during season 1888-89.*

1. PSETTODES ERUMEI, (Bloch).

Günther, Catalogue, iv, 402; Day, Fishes of India, p 422, pl. xci, fig 4.

Met with from False Point to Ganjam, from 10 to 23 fathoms.

2. ARNOGLOSSUS MACROLOPHUS, n. sp., Pl XVIII, Fig. 2.

D. 88-90. A. 67. L. Lat. 55.

Body rather elongate, its height being one-third of the total length. The length of the head is contained nearly  $4\frac{1}{2}$  times in the total, and is equal to its height. The lower jaw projects slightly. The snout is obtuse, almost as long as the eye, and excavated in front of the upper eye.

Eyes on the left side, large, their diameter being contained nearly  $3\frac{1}{4}$  times in the length of the head. A large patent nostril in the excavation of the snout above the upper eye; and two in front of the interorbital space, the anterior being valved. Cleft of mouth very oblique. The length of the maxilla is contained  $2\frac{1}{4}$  times in the length of the head. A single row of small sharp close set uniform teeth in each jaw. The head of the vomer is very prominent. The tongue is styliform. Gill-cleft very wide: the margin of the operculum forms a semicircle. Gill-rakers distant, short, slender, and without any serrations. Integument covered with small scales, strongly and sharply ctenoid on the coloured, cycloid, thin, and excessively deciduous on the blind side. The scales invest the base of the caudal and the lower third of the rays of the vertical fins, at least on the coloured side.

**Lateral line** with a semi-circular curve above the pectoral. **Fins.** The dorsal fin begins in front of the anterior nostril and extends exactly up to the base of the caudal: its first six rays are prolonged, the longest being more than half the total length of the body. The anal is separated from the ventral by a median double-toothed spine, and extends exactly up to the base of the caudal: its rays are similar to the posterior rays of the dorsal. The caudal consists of 17 branched rays, of which the longest are one-sixth the total length of the body: it is obtusely pointed. The pectoral is much more developed on the coloured side, where it is as long as the head exclusive of the snout, and consists of 9 rays: the right pectoral is one-third less than the left in length, and consists of 6 rays. The ventrals are both well developed, and both coloured: the left has 6 rays arranged in a line from the throat to the anal, the right is of the usual form.

*Colours in life*, dull smoky brown with a circumferential row of ill-defined dark blotches just inside the vertical fins, and others along the lateral line. Both ventrals nearly black. Coloured pectoral with a transverse black band in its posterior half.

Total length  $3\frac{1}{3}$  inches.

Locality of capture, 5 miles south of Ganjam in 25 fathoms, on a clean sandy bottom. Only one specimen.

### 3. *BRACHYPLEURA XANTHOSTICTA*, n. sp., Pl. XVII, Fig. 3.

B. G. D. 68-69. A. 44-46. L. lat. 30.

Body rather elongate, its height being one-third of the total length. The length of the head is one-fourth of the total and equal to its height. The lower jaw projects and forms the tip of the snout, and there is a sharp knob at the symphysis. The snout is pointed and is as long as the eye. Eyes on the right side, large, being one-fourth of the head-length in diameter; they are separated by a sharp ridge; the upper is in advance and is very oblique. Nostrils in front of the interorbital space, the anterior being valved: on the left side they are very inconspicuous and are placed almost on the dorsal profile. Mouth wide and forming an almost vertical arch: the maxilla extends behind the level of the lower mid-orbit and is slightly over half the length of the head. Numerous close-set, pointed, conical, curved teeth in both jaws and on the strongly projecting head of the vomer: those in the premaxilla are arranged in a double series anteriorly, and those in the lower jaw are in a double series throughout, the inner row being incurved, while at the symphysis they are in a thick patch. Gill-cleft very wide. Margin of the opercle trilobed. Gill-rakers few, distant, lanceolate and coarsely serrated on their upper surface. Integument covered with large, thin



deciduous scales, which are finely ctenoid on the coloured, cycloid on the blind side. *Lateral line with a wide curve above the pectoral. Fins.* The dorsal begins almost on the upper lip of the blind-side, below the nostrils on that side: the 4th to the 10th rays are elongated in the male only, the 5th to the 7th being nearly half the total length of the body. The anal arises some distance behind the ventrals, its rays are rather less than one-third the body height in length. All the rays of the vertical fins are simple. The caudal has 16 rays, its shape is rhomboidal, and its length one-fifth of the total. The pectorals are set on very obliquely on the coloured and almost horizontally on the blind side: they have 11 rays, and the right (coloured) is rather longer than the left and equal to the caudal. The ventrals have 6 rays; the left arises behind the right. *Colours during life*—body and fins on right side a light sandy brown with numerous longitudinal rows of large bright-orange spots. *Internal anatomy*: there is a simple saccular stomach; the intestine is short and has three long diverticula arising at different levels behind the pylorus.

The length ranges from  $3\frac{1}{2}$  in. to  $4\frac{1}{2}$  in.

Captured 28 miles S. W. of Puri, and 5 miles S. of Ganjam, on both occasions in 25 fathoms and on a clean sandy bottom.

This fish goes beyond the confines of the genus *Brachypleura* (Günther, Cat. iv. 419) in the double row of teeth in the lower jaw, and in the curved lateral line; but one hesitates to construct a new genus on these characters, when there are so many other important points of agreement.

#### 4. PSEUDORHOMBUS RUSSELLII, (J. E. Gray).

Günther, Cat. iv. 424; *Pseudorhombus arsius*, Day, Fishes of India, p. 423, but not *Pleuronectes arsius* of Hamilton-Buchanan's description, Fishes of Ganges, pp. 128 and 373.

Met with commonly near river-mouths and in estuaries.

#### 5. PSEUDORHOMBUS JAVANICUS, Bleeker.

Günther, Cat. iv. 427; Day, Fishes of India, p. 424.

Met with every where from 7 to 23 fathoms. The specimens taken from hard sand are more brightly coloured than those from muddy bottoms.

#### 6. PSEUDORHOMBUS MALAYANUS, Bleeker.

Bleeker, Atlas Ichthyologique, tom. vi, pp. 7-8. pl. cccxxiv, fig 2.

Bleeker distinguishes this species from *P. russellii* by its scales, which are ctenoid on both sides, and by the concavity of the lower

border of the preopercle. But for these characters it is impossible to distinguish the one species from the other, even by colour. Found in the more shallow and turbid waters.

#### 7. PSEUDORHOMBUS TRIOCELLATUS, (Bloch).

Günther, Cat. iv, 428; Day, Fishes, 424; Bleeker, Atl. Ichth. tom. vi, p. 39, pl cccxxix, fig. 1.

This is a very common species. It was taken everywhere usually in 7 to 8 fathoms and on sandy bottoms, where its coloration is much more brilliant than in turbid waters.

#### 8. RHOMBOIDICHTHYS AZUREUS, n. sp., Pl XVI, Fig. 3.

D. 84. A. 64. L. 1. circ. 55.

This species approaches very closely to the description of *R. leopardinus* (Günther, Cat. iv, 434), but its scales are much less numerous—55 rows instead of 80,—and they are remarkably deciduous.

Body oval, its height being a little over half its length, without the caudal. The head is short and deep, with the anterior profile concave between the eyes, its length  $3\frac{1}{2}$  in the total without the caudal, and considerably less than its height. The snout projects conspicuously, its length is hardly half the diameter of the eye, and in the male it bears a short horizontal horn. The length of the eye is two-sevenths of the length of the head; the inner orbital margins are very sharp and in the male knobbed. The lower eye is nearly half a length in advance. The interorbital space is deeply concave, scaly only in its posterior half, and in the male is nearly one diameter, in the female half a diameter of the eye in width.

The nostrils on the blind side are very minute.

The cleft of the mouth is narrow and almost vertical; the length of the maxilla is contained  $3\frac{1}{2}$  times in the head-length. Teeth in a single series in the upper and a double series in the lower jaw; they are close-set, sharp and uniform like the teeth of a comb. Gill-rakers few and distant, on the first arch there are only six. Integument covered with delicate deciduous scales, which are ctenoid on the coloured, cycloid on the blind side. Lateral line with very prominent tubes, and with a strong curve above the pectoral Fins. Dorsal with its longest rays in the anterior part of its last half, where they equal nearly half the head-length. A projection of the humeral arch forms a sharp spine in front of the anal fin.

Length of caudal  $5\frac{1}{2}$  in the total; there are 17 rays. The pectoral on the coloured side is the more developed, having 10 rays, while the right has only 9. The left ventral is much longer and broader than the

right, and occupies the whole median line from the throat to the anal fin: each has six rays. *Colours during life*—dull smoky brown with a series of darker blotches round the coloured side inside the vertical fins. Vertical fins with dark speckles. The male with ten or eleven small brilliant azure spots arranged in two rows on the snout and in front of the interorbital space. Length: male  $3\frac{1}{2}$  inches, females  $3\frac{1}{2}$  to  $4\frac{1}{8}$  inches.

Met with in 7 to 13 fathoms, from 8 to 20 miles S. W. of Puri on muddy bottoms, and once on clean sand.

The fish next to be described might, at first sight, be taken for the immature form of some larger *Pleuronectid*. But after due consideration, and after finding a second very similar yet quite distinct form, I venture to describe both as new, and to provisionally unite their common characters into the diagnosis of a new genus, for which the name *Scianectes*, in allusion to the delicate transparency of the tissues, is suggested.

#### SCIANECTES, gen. nov.

Jaws and dentition equal on both sides. Dorsal fin commencing before the eye, on the snout. Body pyriform and delicate. Mouth small, the length of the maxillary being less than one-third of the length of the head. Teeth minute in a single series in both jaws. Vomerine teeth. Eyes on the left side and close together. All the rays of the vertical fins simple, elongated, weak, and filamentous. Scales minute, membranous, and deciduous. Lateral line with a curve above the pectoral. Gill-membranes united at the throat. Gill-rakers distant and short.

#### 9. SCIANECTES LOPHOTERA, n. sp., Pl. XVI, Fig. 2.

B 5? D. 86-88 A. 66.

Body pyriform, transparent and delicate, its height being contained  $2\frac{1}{2}$  in the total, without the caudal. Head short, its length being  $3\frac{1}{2}$  in the total without the caudal, and three-fourths of its height. Snout obtuse, barely equal to the eye in length. Eyes on the left side situated in the extreme anterior part of the head, separated from each other by a longitudinally grooved ridge; the lower slightly in advance; their diameter one-fifth of the head-length. The cleft of the mouth forms an almost vertical arch. The length of the maxilla is one-fourth the length of the head. Minute teeth in a row in both jaws, and on the vomer. Gill-cleft very wide. Opercle almost membranous. Gill-rakers in the form of distant delicate spines.

Integument covered with minute, delicate, excessively deciduous scales. Lateral line salient, with a semicircular curve above the pectoral,

and continued on to the end of the caudal. Vertical fins of striking height, extremely weak and slender. The longest dorsal rays, which are near the middle of the fin are equal to the head-length in height, and the longest anal rays are slightly longer. The interneural and interhæmal spines are very elongate. The pectoral is much more developed on the coloured side, where if laid forward it reaches to the vertical from the hinder edge of the upper (posterior) orbit.

The ventrals are distinct from the anal: the left is more expanded than the right.

The caudal is long and pointed, being contained five times in the total: it has 17 rays.

*Colours in life.* Transparent white with minute black dots. Three narrow black lines along the body, one of which is the lateral line, while the others follow the lines of origin of the interneural and interhæmal spines respectively. Vertical fins black with irregular milk-white blotches. Left ventral black. Left pectoral grey tipped with black. On the right side, owing to the transparency of the body, the three black lines of the coloured side shew through. Length,  $3\frac{1}{2}$  inches.

Two specimens were taken in 68 fathoms 16 miles E. of the mouth of the Devi river in the Máhánaddi delta, from a soft bottom of very fine sand. The second species of *Scianectes* will be described among the fishes from a deeper and more open part of the Bay.

#### 10. *SOLEA OVATA*, Richardson.

Gunther, Cat. iv, 472; Day, Fishes, p 426, pl xxiii, fig 1.

Met with everywhere, more often on a soft bottom of fine sand and mud, but also on hard sand.

#### 11. *SOLEA OCULUS*, n. sp., Pl. XVIII, Fig. 3.

D 98. A. 65 L 1. 100-102.

This species resembles *Solea hartzfeldii* (Gunther, Cat. iv. 471, and Bleeker, Atlas. Ichth. tom. vi, p. 25, pl. cxxlvi, fig. 1.), from which it differs in the form and arrangement of the dorsal and ventral fins, in the proportions of the head to the body, and in coloration.

Body ovate, its height one-third of the total length. Head with a symmetrically rounded profile, its height being a little greater than its length, which is nearly  $4\frac{1}{2}$  in the total. The snout forms a rostral hook, which curves round behind the symphysis of the lower jaw, touching the vertical from the front edge of the anterior eye. Eyes situated in the middle of the head, the upper half-way in advance of the lower: their diameter is  $6\frac{1}{2}$  in the head-length, and they are about half a diameter apart.

On the coloured side two nostrils in front of the lower eye and nearly on the upper lip, the anterior forming a tube nearly equal to the eye in length, the posterior being a small foramen. On the blind side two nostrils, of which the anterior is perforated in a large fleshy sucker-like papilla.

The cleft of the mouth forms a semicircle with the convexity forwards and upwards, its angle reaches the vertical from the middle of the lower eye. Small villiform teeth in the jaws on the blind side. Gill-cleft narrow. No fringe beneath the lower jaw. Integument invested with small scales ctenoid on both sides. The lateral line is straight on the coloured side, but on the blind side it has a Y-shaped break just behind the gill-cleft.

*Fins.* The dorsal extends from the tip of the rostral hook to the base of the caudal, and the anal is continuous with the right ventral, the united fins extending from the point where the rostral hook opposes the lower jaw to the base of the caudal. The basal fourth of the vertical fins, both rays and interradial membrane, is regularly and evenly invested, on the coloured side only, with rows of small scales.

The caudal has 18 rays; its length is one-eighth of the total. Ventrals with 5 rays: the coloured ventral continuous with the anal, and left ventral connected with its fellow and with the anal by a flap of skin.

Pectorals absent.

*Colours during life.* Ground colour light brown, intersected by a most elegant network of irregular light olive-green lines forming a somewhat pentagonal pattern. Along the dorsal curve are five large, perfect, and complicated ocelli with light-green centre, brown irides, and light green margins. Four similar ocelli along the ventral curve, and another smaller one at the base of the caudal. A few small incomplete ocelli along the lateral line, and numerous dark brown dots and rings-scattered all over the body. Fins transparent grey-green, every fourth or fifth ray uniform dark brown, and the intermediate rays streaked with brown.

Length 4 inches. Two specimens

Taken in 7 fathoms, from a hard sandy bottom, about 32 miles S. W. of Puri.

## 12. SYNAPTURA QUAGGA, (Kaup).

Günther, Cat. iv, 485. [*Synaptura zebra* of Day, *Fishes of India*, p. 430, but not Cantor, nor Bloch's descrip.]

Found all along the coast in 7-10 fathoms.

13. *SYNAPTURA CORNUTA*, (Kaup).

Day, Fishes of India, p. 430, pl. xciv, fig. 4. *Aesopia cornuta*, Kaup, Günther, Cat. iv, 487.

Only one specimen was obtained, a female, in 7-8 fathoms.

14. *CYNOGLOSSUS CARPENTERI*, n. sp., Pl. XVIII, Fig. 1.

D. circ. 100. A. circ. 80. V. 4. C. 10. L. lat. circ. 95.

This species is one of those which has on the left side two nostrils, one of them interorbital, and three lateral lines.

Body tapering acuminate backwards from the gill-opening, the ventral profile bulging strongly just behind the head, and the tail long and slender. The height of the body is nearly  $3\frac{1}{2}$  in the total length, and equal to the length of the head. The snout is an obtuse-angled triangle, and is one-third the length of the head. The rostral hook ends behind the symphysis of the lower jaw. The eyes are prominent, in length one-tenth of the head, separated by a concave space narrower than the eye: the upper is nearly half a length in advance. Two nostrils on the coloured side, one in front of the inter-orbit, the other in front of the lower eye, and tubular. Mouth large, its angle is a whole eye-length behind the posterior border of the lower (hinder) orbit and equidistant between the tip of the snout and the gill-opening. Lips not fringed. Tongue very large, completely filling the mouth. The gill-cleft is high. The opercle is conspicuously expanded below and behind, and the branchiostegal rays and membrane extend a considerable distance behind its edge, giving the appearance of a broad fringe. The integument is invested with small strong scales, which on the blind side and anterior half of the coloured side are cycloid, and on the posterior half of the coloured side sharply ctenoid. Three lateral lines on the left side, the middle separated from the upper by 17, and from the lower by 22 rows of scales at the respective points of greatest divergence: none on the right. Fins: one ventral united with the anal. The vertical fin-rays are delicate; the longest are nearly equal to the snout in length.

*Colours in life.* Left side uniform bright chestnut-brown; the fins a brighter red-brown; the caudal in the female specimen black. The whole of the opercle is blue-black, owing apparently to the pigmentation of the gill-membrane, the extension backwards of which beyond the opercle is black. Intestine nearly one-third longer than the body and convoluted, without diverticula. The ovary of the female was enlarged and crowded with eggs  $\frac{1}{4}$  of an inch in diameter.

Length of male  $6\frac{1}{4}$  inches, of the female  $6\frac{3}{4}$  inches.

Two specimens were taken in 68 fathoms, 68 m. E. of the mouth of the Devi river in the Máhánaddi delta, on a soft bottom of very fine sand.

I have named this species after the distinguished officer in charge of the Marine Survey of India, Commander Alfred Carpenter, R. N., D. S. O., the pioneer of scientific hydrography in India.

15. *CYNOGLOSSUS MACROLEPIDOTUS*, Bleeker.

Günther, Cat. iv, 496; Day, Fishes of India, p. 434, pl. xvi, fig. 3.

Met with usually on soft and muddy bottoms, in 7 to 10 fathoms, off the central part of the delta, where it is exceedingly common, and grows to a length of one foot.

16. *CYNOGLOSSUS OLIGOLEPIS*, Bleeker.

Günther, Cat. iv, 496; Day, Fishes of India, p. 433, pl. xcv, fig. 4.

This species was always found with *C. macrolepidotus*, chiefly on soft bottoms, in 7 to 10 fathoms, where it reaches a length of nearly fifteen inches.

17. *CYNOGLOSSUS QUADRILINEATUS*, Bleeker.

Günther, Cat. iv, 497; Day, Fishes of India, p. 435.

Met with by the 'Investigator' only on bottoms of hard sand, in 6 to 10 fathoms, in the southerly part of the region, 15 to 30 miles S. W. of Puri.

18. *CYNOGLOSSUS LIDA*, Bleeker.

Günther, Cat. iv, 498; Day, Fishes of India, p. 436, pl. xcvii, fig. 3.

A number of specimens were taken on one occasion, with a large number of *C. quadrilineatus*.

19. *CYNOGLOSSUS INTERMEDIUS*, n. sp. ?

D. 106. A. 85. L. 1. 100-103. V. 4. C. 10.

This is a form which has characters similar to those of both *C. lida* and *C. bengalensis*. Only one specimen was taken at the same time with *C. quadrilineatus*, to which also it has a strong superficial resemblance, and with *C. lida*. In appearance it is hardly to be distinguished from the latter, but the ventral fin is united with the anal, the scales are more numerous and less ctenoid, and the head is proportionately longer. In appearance it would not be confounded with the specimens of *C. bengalensis* in the Indian Museum, though the description is not remarkably different. In describing it from a single specimen it is not yet intended to establish a new species.

Symmetrical semicircular snout, abruptly pointed tail.

On the left side two lateral lines separated by 14 rows of scales;

and two nostrils, one in front of the interocular space, the other in front of the lower angle of the lower eye. One lateral line on the blind side. Length of head  $4\frac{1}{2}$  in the total and a little more than its height. Length of eye  $10\frac{1}{2}$  in the head; the upper eye slightly in advance. Interocular space two-thirds the length of the eye in width. The rostral hook ends beneath the eye. The angle of the mouth is in the vertical from the posterior border of the lower orbit and nearer to the gill-opening than to the tip of the snout. Lips not fringed. The length of the snout is  $2\frac{1}{2}$  in the head-length. The height of the body is a little over one-fourth of the total length. One ventral fin united with the anal. The height of the vertical fins is one-fifth the height of the body. Scales ctenoid on both sides. Sepia-coloured, each scale with a light centre and with a dark spot near the middle of its posterior margin.

Total length  $8\frac{1}{2}$  inches.

In 7 fathoms on a bottom of hard sand 32 miles S. W. of Puri. The specimen is a female.

## 20. CYNOGLOSSUS PUNCTICEPS, (Richardson).

Günther, Cat. iv, 500; Day, Fishes of India, p. 437, pl. xcvii, fig. 1.

A single male specimen was taken in 8 fathoms on a soft bottom, off Puri.

## 21. CYNOGLOSSUS BREVIS, Günther.

Günther, Cat. iv, 500; Day, Fishes of India, p. 437, pl. xcvii, fig. 2.

A single female specimen was taken, on a clean sandy bottom, in 7 to 8 fathoms, off the Chilka Lake bar.

## 22. CYNOGLOSSUS SEMIFASCIATUS, Day.

Day, Fishes of India, p. 436, pl. xcvii, Fig. 5.

A single specimen was got in 6 to 10 fathoms on a soft bottom, north-east of Puri.

## 23. CYNOGLOSSUS MELANOPTERUS, Bleeker.

Günther, Cat. iv. 502. [*Cynoglossus monopus*, Bleeker Atlas Ichth. tom. vi, p. 38, pl. cxxlv, fig. 4.]

Six specimens of a fish which appears to be this species were taken in 7 fathoms, between 30 and 35 miles S. W. of Puri. They were caught in the small hand-dredge, which came up full of grass-like seaweed. The movements of this fish, when placed in a large tub of water, were singularly rapid, and it is surprising that it should have been caught in the very narrow mouth of a slow-moving dredge. The larger specimens differ from Bleeker's description in the following particulars: (1) the number of transverse rows of scales is over 120; (2) the lateral



lines are separated by 18 to 19 scales at the level of greatest divergence ; and (3) the upper lateral line is sinuous.

During life, the eyes of this *Cynoglossus* almost resemble the stalked eyes of a gastropod mollusk.

There is a simple saccular stomach, and a simple intestine much convoluted, and exceeding in length the total length of the fish.

This completes the list of the Orissa Coast collection.

Here also may be mentioned the following, as its habitat is very similar to that of the Orissa fishes :—

26. *PLAGUSIA BILINEATA*, (Bloch).

Günther, Cat. iv, 492 : Day, Fishes of India, p. 431.

Taken on a muddy bottom in 4 to 5 fathoms, near the Sacramento shoal, off the Godáviri Delta.

§ 3. *List, with Descriptions, of the Shallow Water Forms obtained during Seasons previous to 1888-89.*

24. *ARNOGLOSSUS POLYLEPIS*, n. sp., Pl. XVI, Fig. 1.

D circ. 82. A. circ. 60. L. 1. 90 to 100.

Body oval, its height being a little over half the total length, without the caudal. Length of head a little over one-third the same length ; its height greater than its length ; its dorsal profile slightly concave in front of the upper eye. Length of the snout not much more than half the length of the eye, which is one-third the length of the head. The lower eye in advance. The interorbital space is a grooved ridge. Nostrils on the coloured side both sub-tubular. Mouth large, the maxilla being two-fifths the length of the head. Teeth small, sharp and uniform, in a single series in both jaws ; in the upper jaw close-set like the teeth of a comb ; in the lower jaw extending further backwards on the right side.

Gill-rakers rather close ; lanceolate.

Integument clothed with very small deciduous scales, which are ctenoid on the coloured, cycloid on the blind side. Lateral line on the coloured side with a strong curve above the pectoral, on the blind side gradually rising without a marked anterior curve. First two rays of the dorsal fin broad and thickened in their basal half, tapering above. The longest dorsal rays, just behind the middle of the fin, are a little more than one-fourth the body height : behind them the rays rapidly shorten, giving the fin an angular outline. The longest anal rays, about the middle of the fin, are two-sevenths of the body height, and the rays behind them diminish in the same way as the posterior dorsal rays. There

is a sharp median pre-anal spine. Left pectoral the more developed, consisting of 8 rays while the right has but six. The left ventral originates in front of the right and is more expanded: both have 6 rays. The caudal has 17 rays, and is  $5\frac{1}{2}$  in the total length. Colours in spirit. Olive brown, with numerous small but complete dark rings, a series of which form a ring round the body just inside the vertical fins. Two conspicuous dark ocelli along the straight part of the lateral line, and another on the posterior limb of the curved part. Fins speckled with black.

Total length  $3\frac{3}{8}$  inches. Taken in 34 fathoms off the E. coast of Ceylon.

25. SAMARIS CRISTATUS, Gray, Pl. XVII, Fig. 4.

Günther, Cat. iv, 420.

D. 80. A. 52. L. lat. 75.

Height of body nearly  $2\frac{3}{4}$  in the total, without caudal. Length of head nearly  $4\frac{1}{4}$  in the total without the caudal; its height being much greater. Length of snout about half the length of the eye; lower jaw slightly prominent. Eyes large, their length  $2\frac{3}{4}$  in the head length; the lower barely in advance; separated from each other by a prominent sharp ridge. Pupil with a semilunar flap from the iris above and below. On the coloured side a long tubular nostril overhangs the upper lip, in front of a simple perforated nostril. Mouth small; its cleft oblique: maxilla one-third the length of the head. Teeth villiform; in several bands in both jaws. Gill-cleft wide. Scales very small, ctenoid on the coloured, cycloid on the blind side. The dorsal fin commences on the snout, its first ray being connected with a flap of coloured skin which passes obliquely across the snout, behind the mouth, on the blind side. The first thirteen rays are elongated, so that, when laid back, they reach in two specimens to the 67th ray, and in one beyond the base of the caudal. These rays are broad and stout. The remaining dorsal rays are slender, those in the posterior fourth being longer than the rest, and equal to half the height of the body. The longest anal rays are equal to, and opposite these. The right pectoral, which consists of four stout rays, is elongate, and equal to the greatest height of the head: it is set on very obliquely. There is no pectoral fin on the left side. Ventrals with 5 rays, those of the right fin elongate, and spatulate at their free ends; the first ray being of nearly equal length with the pectoral. Left ventral well developed, but not prolonged. Caudal with 16 rays, inclined slightly downwards; its length is about one-fifth of the total. Sepia-coloured, in spirit, beautifully mottled with purple-brown and black, in a sinuous ring round the whole side: outside this the

ground colour is lighter. The colours and their arrangement recall the appearance of certain stone-encrusting lichens. Snout white: anterior prolonged dorsal rays black at the base, and pure milk-white throughout their free extent: the rest of the dorsal fin, and the anal, dark sepia with black blotches and a row of small white dots: pectoral black: right ventral striped black and white: left ventral grey tipped with black. The total length of the specimens ranges from 2 to  $2\frac{3}{4}$  inches.

Taken in 34 fathoms, off the E. coast of Ceylon.

§ 4. *Descriptions of the Deep-Sea Forms obtained from the Commencement of the Survey to date.*

Three new deep-sea fishes have next to be described, namely, a second species of the new genus *Scianectes*, and two species of the genus *Aphoristia*.

27. *SCIANECTES MACROPHthalmus*, n. sp., Pl. XVI, fig. 4.

B. 6. D. 88. A. 68.

Body pyriform, transparent and very delicate; its height not quite  $2\frac{3}{8}$  in the total, without caudal. The length of the head is one-third of the total, without caudal, and the height rather more. The snout is obtuse and half as long as the eye. Eyes on the left side, their diameter  $3\frac{1}{2}$  in the length of the head; the lower slightly in advance, and separated from the upper by a downward shelving ridge. Cleft of mouth nearly vertical: the maxilla being  $3\frac{1}{2}$  to  $3\frac{3}{8}$  in the length of the head. Minute teeth in a row in each jaw, and in a patch on the vomer. Gill-cleft wide; opercles thin; branchiostegal rays prolonged. Gill-rakers distant, lanceolate. Body covered with minute, thin, and very deciduous scales. Lateral line salient: it has a rather shallow curve above the origin of the pectoral, and is continued along the caudal. The dorsal fin commences on the snout; its longest rays are a little more than half the length of the head, and slightly shorter than the longest anal rays. Internural and interhaemal spines long. A small median pre-anal spine. The pectoral is more developed on the coloured side, where if laid forward it reaches to the middle of the lower (anterior) eye. Ventrals six-rayed; the left more expanded than the right. Caudal long and pointed, with 17 simple rays; its length one-fifth of the total. Colours—left side white, with a few minute black dots. The body is traversed by three narrow black longitudinal lines, one of which is the lateral line, while the others follow respectively the outlines of the tips of the neural and haemal spines; vertical fins black; left pectoral grey at its base and black in its posterior two-thirds; left ventral black; prolongation of the left branchiostegals and membrane black. Total length  $3\frac{1}{8}$  inches. One specimen.

Taken 40 miles S. W. of Akyab, in 100 fathoms.

The two species of *Aphoristia* have certain points in common : both sides of the body are coloured, there are two nostrils on the eye side, the cleft of the mouth is almost horizontal, and the anterior dorsal rays are rather widely separated and inter-connected by membrane only at their bases.

28. *APHORISTIA GILESII*, n. sp., Pl. XVII, Fig. 2.

D. 97-98. A. 83-85. C. 14. V. 4.

Body lanceolate ; its greatest height, which is anterior to the vertical middle, is just over one-fourth of the total. The head is much expanded downwards in the opercular region ; its length is contained  $4\frac{1}{2}$  times in the total, and is  $5\frac{2}{3}$  times the length of the snout, the outline of which anteriorly is abruptly truncated.

The snout and jaws are covered with small scales.

The eyes are well within the anterior third of the head, and almost exactly on the same level : their length is nearly one-eighth that of the head. The interocular space is scaly, the scales encroaching on the margins of the eyes. A simple perforated nostril in the anterior part of the interorbit, and a tubular one about half as long as the eye midway between the lower eye and the tip of the snout. No nostrils on the blind side. Cleft of mouth horizontal, with a slight down-curve at its angle, which is in the vertical from the middle of the eye.

Dentition feeble ; on the blind side only. Gill-cleft narrow and low : branchiostegal rays and membrane prolonged downwards and backwards considerably beyond the edge of the operculum. Scales of moderate size, ctenoid on both sides, and so deciduous that their number could not be correctly counted. The dorsal fin begins over the middle of the upper eye : its first eight rays are separated by wide interspaces, and (apparently) connected by membrane only at their bases : the longest rays are near the middle of the fin and are contained  $2\frac{7}{8}$  times in the body height. The distance of the origin of the anal from the snout is equal to the body-height : the longest anal rays are slightly longer than the longest dorsal.

The ventral arises between the gill-covers, and is separated from the origin of the anal by little more than an eye-length. Length of caudal  $8\frac{3}{4}$  in the total.

Both sides are coloured, recorded in life as "Earth colour with parallel brown lines." In spirit, it is yellow with numerous fins parallel brown lines extending along the body from head to caudal : fins brown. Total length,  $4\frac{7}{8}$  inches. One specimen.

Locality. Lat  $20^{\circ} 17' N$ . Long  $88^{\circ} 51' E$ . 193 fathoms. I have

named this species after Dr. G. M. Giles, who, in the 'Investigator,' has added so many deep-sea fishes to the Indian collection.

29. APHORISTIA WOOD-MASONI, n. sp., Pl. XVII, Fig. 1.

B. 5. D. 90. A. 78. C. 14. V. 4. L. lat. circ. 85. L. tr. circ. 84.

Body lanceolate; its greatest height, which is just behind the vertical middle, is  $4\frac{1}{2}$  in the total. Head much expanded in the opercular region; its length  $5\frac{7}{8}$  in the total, and  $4\frac{2}{3}$  times the length of the snout, which terminates in an abrupt straight edge.

Snout and jaws covered with small scales. Eyes situated just within the anterior third of the head; the upper very slightly in advance; their length one-seventh that of the head.

The interocular space is scaly, with two rows of scales, which encroach on the margins of the eyes. There is a simple nostril between the eyes anteriorly, and a tubular nostril as long as the eye midway between the lower eye and the tip of the snout. Cleft of mouth horizontal, with a slight down-curve at its angle, which hardly passes behind the vertical from the front edge of the lower eye. Dentition feeble, and more developed on the blind side. Gill-cleft low: branchiostegal rays and membrane prolonged beyond the opercular edge. Scales ctenoid on both sides: rather deciduous. The dorsal fin begins above the middle of the upper eye: its first two rays are approximated, but the next seven are separated by wide interspaces and connected together only in their lower part: the longest dorsal rays, near the middle of the fin, are contained  $3\frac{1}{2}$  times in the body height, and the longest anal rays are slightly longer. The distance of the origin of the anal from the snout is equal to the body-height. The ventral is separated from the anal by almost its own length. Length of the caudal one-ninth of the total. Colours in spirit, bluish-grey on both sides, with a broad blue-black band all round each side, occupying the whole extent and breadth of the regions of the inter-neural and interhaemal spines, and very numerous parallel black lines extending from snout to caudal through the middle of each row of scales: opercle black: fins black, except the caudal which is grey. Total length 5 inches. One specimen.

Dredged  $7\frac{1}{2}$  miles E. of North Cinque Island (Andamans), in 490 fathoms, by Professor Wood-Mason on board the 'Investigator.'

EXPLANATION OF THE PLATES.

PLATE XVI.

- Fig. 1. *Arnoglossus polylepsis*, n. sp.  
Fig. 2. *Scianectes lophoptera*, n. sp.  
Fig. 3. *Rhomboidichthys azureus*, n. sp., female.  
Fig. 4. *Scianectes macrophthalmus*, n. sp.

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PLATE XVII.

- Fig. 1. *Aphoristia wood-masoni*, n. sp.  
Fig. 2. *Aphoristia gilesii*, n. sp.  
Fig. 3. *Brachypleura xanthosticta*, n. sp., male.  
Fig. 4. *Samaris cristatus*, Gray.

PLATE XVIII.

- Fig. 1. *Cynoglossus carpenteri*, n. sp., female.  
Fig. 2. *Arnoglossus macrolophus*, n. sp.  
Fig. 3. *Solea oculus*, n. sp.
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XVII.—*Natural History Notes from H. M.'s Indian Marine Survey Steamer 'Investigator,' Commander, ALFRED CARPENTER, R. N., D. S. O., Commanding. No. 12. Descriptions of some new and rare species of Fishes from the Bay of Bengal, obtained during the season of 1888-89.—By ALFRED ALCOCK, M. B. (ABER.), Surgeon-Naturalist to the Survey.*

[Received Sept. 13th ;—Read November 6th, 1889.]

(With Plate XXII.)

The fishes described in this paper were taken by the trawl during the last season's survey work on the East Coast of the peninsula. There are in all ten species, of which seven are new to science, while the remaining three appear for the first time as Indian fishes.

One only is a strictly shore fish : the others were obtained in depths ranging from 25 to 68 fathoms, most of them in the greater depth.

The deep-sea forms met with by the 'investigator' will be considered separately ; but from this present account of the produce of a few occasional hauls of the trawl, made, when time permitted, in the course of delimiting the hundred-fathom line, it will be seen how rich and how full of promise are the extra-littoral waters of India.

Though the fishes now described are from the off waters of the East Coast, some of them were met with in other localities, and these localities are also recorded.

#### Family PERCIDÆ.

A *Apogon*-like fish, near *Chilodipteus*, *Pomatomus*, and *Scombrops*, its closest resemblance being to the last, was taken on two occasions in moderate depths. It is distinguished from *Scombrops* most conspicuously by the structure of the spinous dorsal, and of the preoperculum. In recognition of its nearest alliance I propose the name *Parascombrops*, diagnosed by the following characters.

Seven branchiostegals. Jaws with canines : villiform teeth on palate and vomer : tongue smooth. Two separate dorsal fins, the first with 9 spines. Anal with 2 spines. Operculum naked, with weak spines. Preoperculum with a double serrated edge. Scales large and deciduous. Pseudobranchiæ.

*PARASCOMBROPS PELLUCIDUS*, g. et sp. nov., Pl. XXII, Fig. 1.

B. 7. D.  $9\frac{1}{2}$ . A.  $\frac{3}{2}$ . L. lat. circ. 28. Cæc. pyl. 5. P. 17. V.  $1\frac{1}{5}$ . C. 24.

Body rather elongate and compressed ; its height a little more than one-fourth the total. Head compressed and somewhat angular, with

well-developed muciferous cavities: its length (excluding a membranous extension backwards of the operculum)  $3\frac{1}{2}$  in the total. The lower-jaw is strongly prominent, with a strong sub-symphysial knob, which forms the tip of the snout. Preoperculum with a double border: the outer border recurved at its angle and strongly serrated there and along its horizontal limb; the inner with three small spines at its angle. Operculum naked, with two weak spines; its angle has a membranous extension backwards to the level of the anterior third of the pectoral fin. Snout, with the projecting lower jaw, as long as the eye, which is  $3\frac{1}{2}$  in the head as above limited. Interorbital space narrower than the eye, nearly flat from side to side, and marked with obliquely converging lines which bound the muciferous cavities of the skull. Nostrils large.

Cleft of mouth very oblique, and wide: the mandibles emarginate on either side of the symphysis. Villiform teeth in premaxillæ, vomer, palatines, and front of mandibles: in addition, a pair of strong fang-like canines anteriorly in the upper jaw, and four large and five or six small upstanding recurved teeth on each side of the lower, and a single similar tooth of medium size near the symphysis. Gill-cleft wide: gill-rakers close-set, numerous, and nearly half as long as the eye. Scales excessively deciduous: one from the abdomen is  $\frac{3}{16}$  of an inch in diameter, with a vertical, crenated posterior edge. The dorsal fins are separated by an interspace equal to three-fourths the length of the eye: the spinous is considerably the higher: the 1st spine is small, the 3rd is the longest and is equal to two-thirds of the body height, the 4th is nearly as long. The 1st anal spine is short, the 2nd as long as the eye. Caudal forked almost to its base, forming two distinct lobes. Pectoral delicate; its length equals the distance from the tip of the snout to the anterior pre-opercular edge. Ventral long, reaching two-thirds of the distance to the anal: its spine is long, having its outer edge set-close with small uniform recurved spines. Colours in life, transparent light brown suffused with the pink reflex of the great vessels: opercular and visceral regions like burnished silver.

Total length  $3\frac{3}{16}$  inches. The intestine is long and much coiled; and there are five very large pyloric cæca.

Taken in 68 fathoms 16 miles east of the Devi mouth of the Mâhâ-naddi delta. A similar sized female specimen with ripe ovaries was taken in 65 fathoms (temperature  $62^{\circ}$  Fahr.) in Lat.  $20^{\circ} 18' N.$ , Long.  $90^{\circ} 50' E.$

#### Family SCORPÆNIDÆ.

Two species of *Sebastes* were obtained in less depths than the above. One of them appears to be *Sebastes serrulatus*, (Richardson); and I venture to describe it under that name.



## SEBASTES SERRULATUS. Pl. XXII, Fig. 2.

Richardson, Report on the Ichthyology of the Seas of China and Japan, p. 215 ;  
Günther, Cat. ii., 106.

D.  $12\frac{1}{3}$ . A.  $\frac{3}{2}$ . L. lat. circ. 45 ; P. 15. V.  $1\frac{1}{5}$ . C.  $3\frac{14}{13}$ .

Body compressed ; its height  $3\frac{1}{2}$  in the total, and equal to the length of the head. Head uniformly scaly, with all its crests low and crenated. Preorbital edge crenate ; preopercular border dentate ; operculum with a single weak spinous point. The occipital and temporal regions are traversed each by a rugose ridge ; and the cheek is crossed, from pre-orbital to pre-opercular angle, by a broad double-crested crenate ridge. Snout deep with a narrow excavation between the premaxillæ : its length is equal to that of the eye, which is  $3\frac{1}{4}$  in the head-length. The interorbital space is a deep scaly furrow ending anteriorly in a pit. The supraorbital ridge is three crested, the edge of each crest being crenated. Cleft of mouth very oblique. The maxilla reaches beyond the level of the middle of the eye ; its hinder expanded end is scaly, and its anterior two-thirds has a median longitudinal upstanding serrated crest.

Each limb of the lower jaw is traversed by three parallel serrated crests with scaly interspaces. Tongue free. Villiform teeth in the jaws and on the projecting head of the vomer : none on the palate. Gill-opening wide : the last gill-cleft is reduced to a small foramen. Scales very thick, of moderate size, bluntly-ctenoid on the back and sides, cycloid on the abdomen. The first two and the third and fourth dorsal spines are isolated : the first is short ; the third, fourth, and fifth are of equal length—two-fifths of the head. The soft dorsal is separated from the spinous by a deep notch ; its middle rays are half the length of the head ; its last ray is double. The 3rd anal spine is the longest and strongest. The length of the caudal is a little more than one-fourth the total. The pectoral is broad and long with a scaly base : it reaches as far as the posterior edge of the base of the anal. The ventral rays are equal in length to the anal. Colours in life, bright scarlet, with a series of five indefinite transverse red-brown bands not reaching the abdomen : a large iridescent dark-blue circular patch on the operculum : pectoral rays bright yellow : irregular rows of dark brown blotches on the fins. Length,  $4\frac{1}{2}$  inches.

One specimen taken off Ganjam in 23 fathoms, on a soft bottom.

## SEBASTES MUCIPARUS, sp. n., Pl. XXII, Fig. 3.

B. 7. D.  $12\frac{1}{3}$ . A.  $\frac{3}{2}$ . L. lat. 70. P. 19. V.  $1\frac{1}{5}$ . C.  $2\frac{16}{11}$ .

Height of body  $3\frac{1}{4}$ , length of head about 3, in the total. Snout sharp, as long as the eye, which is  $3\frac{3}{8}$  in the head-length ; with a wide

inter-maxillary notch, into which the knobbed symphysis of the lower jaw fits. A pair of upstanding nasal spines, and a pair of short nasal filaments. The pre-orbital margin has four spiny points; the preopercular margin four sharp spines and a short filament; and the operculum two diverging bony stays ending in flat spines. The interorbital space narrows in the middle, where its width is only half an eye-length; along its floor is a median groove with serrated edges. The supra-orbital ridge is sharp and salient, with four large reverted spines, and with a short supra-ocular filament below. Two sharp reverted spines, one behind the other, in the occipital region; and a row of three in the temporal region. A strong ridge, with six similar spines, extends across the cheek. Cleft of mouth oblique; the maxilla, which is naked, reaches the vertical from the hinder margin of the orbit. Villiform teeth in both jaws and on the very strongly projecting head of the vomer: none on the palate. Tongue free. A large muciferous canal, with several distant large circular openings, extends along the free margin of the preoperculum and the limb of the lower jaw up to the symphysis. Gill-opening wide. One strong humeral spine.

Scales ctenoid; small, and becoming very minute on the head and abdomen. The lateral line shows as 22 double keel-like spines. 1st dorsal spine very short; the 4th and 5th are the longest and strongest—equal to  $\frac{2}{3}$  the body height in length: the middle rays of the soft dorsal are equal to half the body height. 1st anal spine very short, the 2nd stout, the 3rd the longest, but slender. The length of the caudal is about  $4\frac{1}{2}$  in the total: that of the pectoral is a little greater than the body height. The ventral spine is very strong. Colours: body and fins bright red: a series of four transverse broad dark bands across the back and sides, and irregular rows of dark-red and brown spots on the fins: a black blotch in the posterior part of the spinous dorsal. Total length,  $3\frac{3}{4}$  inches.

Captured 26 miles N. by E. of Gopalpur in 45 fathoms: bottom mud.

One specimen.

*MINOUS INERMIS*, sp. n., Pl. XXII, Fig. 4.

B. 7. D.  $1\frac{1}{2}$ . A.  $\frac{2}{3}$ . P. 11/1. V. 1/5 C. 13.

Distinguished by feeble armature of head, and flexible spines.

Head and body much compressed. Height of body about one-fourth, length of head about one-third of the total. Edge of pre-orbital with two short flat diverging spines. Preoperculum with a spine at its angle, and dentations along its lower edge. Operculum with two weak diverg-

ing stays not, or hardly, projecting as spines. A low crenate ridge across the cheek; and a similar ridge across the occipital, and another across the temporal region. Snout as long as the eye, or one-fourth the length of the head. Interocular space narrower than the eye; with a median longitudinal groove; and bounded by thin sharp crenate supra-orbital ridges.

Cleft of mouth wide and oblique. The maxilla is much expanded behind. A barbel about the middle of the limb of the lower jaw. Villiform teeth in the jaws and palatines. Gill-opening wide: the posterior gill-cleft is a small foramen. Gill-rakers close-set and numerous. Integument comparatively thin, without scales: it invests all the fins. The lateral line shows as 17 to 18 tubular papillæ. All the fin-rays are simple. Dorsal fins continuous, the soft portion being the higher: all the spines are weak and flexible, the 1st being very small. Anal spines hidden, the 1st being visible only on reflecting the skin. Caudal about one-fifth of the total length. Pectoral as long as the head: its free filament reaches to the 3rd anal ray. Ventral nearly half as long as pectoral. Colours in life:—rosy red with white and gray mottlings and minute black dots; throat and barbels white; pectoral, ventral, and anal fins edged with black. Total length  $2\frac{1}{4}$  inches.

Taken in 70 fathoms, east of the Sacramento shoal on the Godáviri coast.

Two specimens; the body of one of them almost completely invested by a colony of hydroid polyps (*Podocoryne*, sp.).

#### Family SCIÆNIDÆ.

##### SCIÆNA OPHICEPS, sp. n.

D.  $10\frac{1}{27}$ . A.  $\frac{2}{7}$ . L. lat.  $\frac{60}{50}$ . L. Tr.  $\frac{6-7}{16-18}$  (usually 16).

P. 20. V.  $1\frac{1}{5}$ . C. 17.

Body elongate low and compressed; head long low and pyramidal. The dorsal profile makes a straight ascent, at an angle of about  $23^\circ$ , from the tip of the snout to the first dorsal spine, and thence abruptly makes an almost straight descent, at an angle of about  $10^\circ$  with the horizon, to near the base of the caudal. Height of the body  $4\frac{1}{4}$  to  $4\frac{3}{8}$ , length of head  $3\frac{2}{3}$  to  $3\frac{5}{8}$ , in the total. The height of the head equals its length behind the middle of the orbit. The snout is acutely pointed; its length is equal to a diameter and a half of the eye, which is  $5\frac{1}{2}$  in the head-length; not overhanging the mouth. The upper jaw overlaps the lower, so that when the mouth is shut the anterior canine-like teeth project like fangs. The tip of the snout has three large pores, and a free bi-lobed flap of skin with a wide pocket-like pore between the lobes, each

lobe with a similar pore. The interorbital space is nearly flat from side to side, and as broad as the eye is long. Nostrils large. Mouth oblique; the maxilla reaches the vertical from the posterior border of the orbit. Lips thick, and beset with filiform papillæ, the upper lip most thickly so. Villiform teeth in both jaws: in the premaxillæ an outer row of sharp curved teeth of which the anterior four are canine-like; in the mandibles an inner row of distant sharp conical teeth. Preopercular margin finely serrated, with some small spiny teeth at its angle: two weak opercular points. Gill-rakers on the inner edge of first arch bacillate; on the other arches in the form of sharply-toothed double-crowned tubercles. Scales ctenoid, except on snout and infra-orbital. All the dorsal spines weak and flexible; the 1st very small, the 3rd and 4th the highest and equal to nearly half the body height. 1st anal spine almost invisible; the 2nd a little longer than the eye, and not half the length of the rays. Pectorals large and falciform, in length equal to the head without the snout, or to the body height. Ventrals two-thirds the length of the pectorals. Caudal a sharp-pointed wedge; its length  $5\frac{1}{2}$  to  $5\frac{3}{4}$  in the total. Colours in life: back silvery shot with metallic green and red; belly like burnished silver: a blue blotch on operculum; pectorals yellow, the other fins grey suffused with orange. The stomach with its cæcum occupies nearly the whole length of the abdominal cavity: its walls are very thick, and in addition to the simple tubular follicles of the mucosa, there are some coiled tubular glands in the submucosa. There are six pyloric appendages. The air-bladder is large and strong, with a long terminal spur and 28 lateral arborescent appendages on each side.

The largest specimen is 11 inches long.

Localities: off the Máhánaddi delta in 5 to 9 fathoms; and off the Godávári delta in 4 to 5 fathoms.

#### Family TRACHINIDÆ.

An *Uranoscopus* which agrees in almost every detail with *Uranoscopus cognatus* (Cantor) was taken at two or three stations near shore; and *Champsodon vorax* (Gthr.) was found three times in deep water.

#### URANOSCOPIUS COGNATUS.

Cantor, Catalogue of Malayan Fishes, p. 21, (or J. A. S. B. Oct. 1849, p. 1008); Günther, Cat. ii, 227.

Our specimens have not the pectoral rays tipped with scarlet; and the 15th dorsal ray seems to be only a branch from the base of the 14th. Some have a small supra-ocular filament. There are 24 vertebrae. The

opercular border is completed by a tough membranous extension upwards of the suboperculum. Of the three pairs of spines beneath the lower jaw, the anterior are the sharp ends of the clavicles, and the others are processes from the pubic bones. A specimen dissected had the ovaries much enlarged, the ova being  $\frac{1}{8}$  of an inch in diameter.

Length of largest specimen,  $5\frac{1}{2}$  inches.

Localities: Off False Point, in 10 fathoms: 28 miles S. W. of Puri, in 25 fathoms: 5 miles south of Ganjam, in 25 fathoms.

#### CHAMPSODON VORAX.

Günther, Proc. Zool. Soc., 1867, p. 102; and Zool. Challenger, vol. i, pt. vi, pp. 52, 43, and 56, pl. xxiii, fig. A, and vol. xxii, p. 49.

Our specimens all have the radial formula D. 5/21, A. 19. There is a pair of sharp diverging spines on each pre-orbital margin, and a similar pair on the lower border of the preoperculum. Two parallel ridges pass from the snout, above each eye, to the occiput, where they diverge to terminate in a sharp bifid spine on the tympanic region. There are transverse rows of small milk-white (in spirit) papillæ on the head and body. Diameter of scales  $\frac{1}{10}$  inch, the free edge with four or five sharp teeth about two-thirds the diameter of the scale in length. Colours in life:—dorsum metallic green; belly silvery: spinous dorsal black: caudal with a dark base and black edge.

Total length of the largest specimen 5 inches.

Localities: 16 miles E. of mouth of Devi river in the Máhánaddi delta, in 68 fathoms: [Bay of Bengal, Lat.  $20^{\circ} 18' N.$  Long  $90^{\circ} 50' E.$ , in 65 fathoms, bottom temperature  $65^{\circ}$  Fahr.: 40 miles S. W. Akyab, in 100 fathoms, bottom temperature  $62^{\circ}$  Fahr.]. In the 'Investigator' collection from the Malabar coast is a single specimen an inch and a half long, taken in 28 fathoms.

#### Family PEDICULATI.

Specimens of a small *Lophius* were taken on one occasion in a moderate depth. It bears a close resemblance to *L. setigerus* (Wahl), but I am unable to identify it with the descriptions of that fish, and propose to regard it as a distinct species.

#### LOPHIUS INDICUS, sp. n.

D. 3/3/8. A. 6-7. C. 8. P. 23. V. 5.

Cephalic disk enormous; half the total length, including caudal; its vertex studded with spinous tubercles, and its margin completely fringed with skinny appendages which are continued along the middle

line of the body and tail to the base of the caudal. Long diameter of the eye about one-tenth the head length. The supra-orbital margin prominent, with two large simple spines. Interorbital space concave; two eye-lengths in breadth. Mouth as broad as the disk: the anterior part of its floor, with the tongue and upper surface of the branchial arches, coloured like the body. Teeth sharp and depressable inwards: in two series in the upper, three in the lower jaw, the outer series in both jaws being very small. Two teeth on each side of the vomer, and three or four in a row on the palatines. Gills three. Branchiostegals five. Humeral spine bifid. First dorsal spine slender, naked, and ending in a tuft: the second with a fringed edge: the third bristle-like.

Colours in life: dorsum dark grey reticulated with narrow black vermicular lines: belly and throat colourless. The stomach is a globular sac; the intestine long and coiled; and the two pyloric appendages very large and long. Total length;  $1\frac{3}{4}$  inches.

Locality: 5 miles S. of Ganjam, in 25 fathoms, on a clean sandy bottom.

Among the 'Investigator' collections is a specimen of this fish  $3\frac{1}{2}$  inches long, taken in 28 fathoms off the Malabar coast. In this specimen the humeral spine has two smaller diverging spines at its base.

#### Family COTTIDÆ.

##### PRIONOTUS ALEPIS, sp. n., Pl. XXII, Fig. 5.

This little fish seems to be very closely allied to *Prionotus birostratus* (Richardson), from which it differs in having a scale-less integument. Before describing it, its points of community with *P. birostratus* may be reviewed, after Jordan and Hughes' scheme (Proc. U. S. Nat. Mus. 1886, vol. ix, pp. 327-338).

Dorsal spines 10, rays 13: anal rays 11. Mouth comparatively large, the maxilla being two-fifths of the head-length, and the mandible extending to the vertical from the front edge of the eye. No cross groove on the top of the head. Free rays of pectoral tapering, and not expanded at the tip. Black patch on spinous dorsal diffused over more than two spines, and not ocellated. Preopercular spine with a distinct smaller one at its base. Gill-rakers slender and tapering.

Pre-orbital produced beyond the snout. Spines on the head well-developed. Pectoral fins truncated.

#### Description.

D. 10/13. A. 11. P. 12/3. V. 1/5. C. 20.

Head of enormous relative size, being longer (caudal excluded), higher, and wider than the compressed body. Outline of the body triangular, with a crescentic expansion at the base of the caudal. Snout

bill-shaped, with two horizontal, advanced, serrated horns formed by the prolongation of the preorbitals, and with a strong median knob. The eyes, which are rather more than two-sevenths the length of the head, diverge from one another behind, where they are a little more than a diameter apart. The concave interorbital space is bounded by prominent sharp supra-orbital margins, in the middle of which is a broad upstanding spine with recurved tip. On each side of the origin of the spinous dorsal is a sharp serrated occipital spine, as long as the eye. Operculum with a transverse ridge ending in a small spine. Preoperculum with two spines at its angle, one behind the other; and three dentations along its lower border. Mouth large and broad. Minute teeth in jaw, palate, and vomer.

Gill-openings wide: the branchiostegals a good deal uncovered by the operculum, in repose. Gill-rakers close-set; in form like long pointed bristles. No scales. The lateral line, which consists of 16 close-set prominent tubes diminishing in size from before backwards, extends only as far as the vertical from the 1st dorsal ray. The spinous dorsal is higher than the soft; the 2nd, 3rd, and 4th spines are the strongest and highest, being rather over half the height of the head. The anal rays are longer than the soft dorsal rays. The caudal is very large, deeply forked, and half as long as the head. The pectoral reaches as far as the base of the last anal ray; and the first free ray nearly as far. The ventral is four-fifths the length of the pectoral: its spine is very strong and sharp. Colours in life: body light sea-green with two irregular lines of purple-brown blotches along the dorsum: head mottled with tortoise-shell, green, and blue: spinous dorsal light brown, with an oval black patch extending from the third to the sixth spines: soft dorsal transparent grey, traversed by an oblique dark band: anal ventrals and caudal transparent grey, the last with a V-shaped dark band at its base. Pectorals mottled and blotched with green, brown, orange, and yellow: their free filaments rosy red.

Two specimens, the longer of which is  $1\frac{7}{8}$  inch.

Taken in 68 fathoms, 16 miles east of the mouth of the Devi river in the Māhānaddi Delta.

The discovery of a *Prionotus* in the Indian Seas is highly interesting.

#### Family MURENIDÆ.

In the same very productive 68 fathoms haul a most curious Murenid was obtained. In Dr. Günther's scheme (Günther, Cat. viii, 19-20), it would come between the *Myrina* and the *Ophichthyina*, having a dentition similar to some *Ophichthyines*, with a *Myrine* tail. Its most peculiar character is found at the tip of the snout, where there is a bone

of bone, formed apparently by an expansion of the premaxillaries, covered with teeth. I do not think this fish can be placed in any hitherto established genus; and I propose for it the generic name *Bathymyrus*, with the following diagnosis (after Dr. Günther's scheme):—

Branchial openings in the pharynx are wide slits. Tail longer than the trunk. Heart situated immediately behind the gills. Muscular and osseous systems well-developed. Gill-openings separated by an interspace. Nostrils labial. Tongue not entirely free. End of the tail surrounded by the fin. Pectorals well-developed. Dorsal fin commencing immediately behind the gill-opening. Teeth in the jaws uniserial. Inter-maxillary forming the end of the snout.

*BATHYMYRUS ECHINORHYNCHUS*, gen. et sp. n., Pl. XXII, Fig. 6.

Body cylindrical anteriorly, compressed posteriorly. Tail longer than the body by one-half. Head, excluding the branchiostegal region, one-seventh of the total: cylindrical, tapering slightly: the masticiferous cavities well-developed. The snout projects beyond the lower jaw; it is as long as the eye, which is one-fifth of the head as above limited; and its tip is formed by a massive upward and lateral expansion, studded with small curved teeth, of the premaxillaries. The nostrils are in contact with the margin of the upper lip; the anterior being tubular and situated near the end of the snout, the posterior being valved and placed in front of the lower border of the eye. The gape of the mouth extends a little behind the vertical from the posterior border of the orbit. There is a single series of close-set, uniform, small sharp teeth in the maxillæ and in the mandibles: a few similar teeth on the vomer at its junction with the premaxillaries, and a cluster of sharp down-curved teeth on the extra-oral rostral expansion of the premaxillaries. The tongue is long and attached up to its tip by an extensible frenum. The gill-openings extend obliquely from the upper edge of the base of the pectoral almost to the middle line of the abdomen, where they are separated by a narrow interspace. The gill-laminæ are long, coarse, and cylindrical. The branchiostegal region is one-third the length of the head. There is an oblique bony stay across the operculum. The integument is scaleless. The pectorals are longer than the greatest body height. The dorsal begins above the origin of the pectorals. The caudal is well-developed, confluent with the vertical fins, and with a truncated tip. Colours in life, transparent grey with numerous minute specks of black.

Total length of the single specimen  $10\frac{1}{2}$  inches.

Locality: 16 miles east of the mouth of the Devi river in the Mâhâ-naddi delta in 68 fathoms.

I have to record my deep obligations to Professor Wood-Mason for the advice and help which he has so kindly given me in all my work.



XVIII.—*The Ethiopian and Oriental Representatives of the Mantodean Subfamily Vatiidæ.*—By J. WOOD-MASON, Superintendent of the Indian Museum, and Professor of Comparative Anatomy in the Medical College of Bengal, Calcutta.

[Read November 6th, 1889.]

Genus 1. DANURIA, Stål.

*Danuria*, Stål, Öfv. Kongl. Vet.-Akad. Förh. 1857, p. 169; 1872, p. 387, ♂; Bih. Kongl. Vet.-Akad. Handl. 1877, pp. 69-70, ♂ ♀.—Saussure, Mém. Orthopt. 1870, t. i, p. 309.

DISTRIBUTION.—South and East-African sub-regions of the Ethiopian Region.

1. DANURIA THUNBERGI, Stål.

*Danuria thunbergi*, Stål, Öfv. Kongl. Vet.-Akad. Förh. 1857, p. 169; 1872, p. 383, ♂.—Saussure, Mém. Orthopt. 1870, t. i, p. 444, pl. v, figs. 66, 66a, 67, ♂ ♀.—de Bormans, Ann. Soc. Ent. Belg. 1881, vol. xxv, p. 23.

HAB.—Natal (Stål); South Africa (Saussure, de Bormans).

2. DANURIA BOLAUANA, Saussure.

*Danuria bolauana*, Saussure, Bull. Entom. Suisse 1869, t. iii, p. 79, ♂; Mém. Orthopt. 1870, t. i, p. 310, ♂.—de Bormans, Ann. Soc. Ent. Belg. 1881, vol. xxv, p. 22.

HAB.—Zanzibar (Saussure); South Africa (de Bormans).

3. DANURIA SUPERCILIARIS, (Gerstaecker).

*Mantis* (*Danuria*?) *superciliaris*, Gerstaecker, Arch. f. Naturgesch. 1869, xxxv Jahrg., i Band, S. 210, et v. d. Decken's Reisen in Ost-Afrika, iii Band, ii Abt., S. 15, Taf. 1, fig. 7, 7a., 7b., ♀ nymph.

HAB.—Wanga, East-Africa.

Possibly an immature female of the preceding.

4. DANURIA ELONGATA, de Borre.

*Danuria elongata*, de Borre, Liste d. Mant. Mus. Roy. Hist. Nat. Belg. 1883, p. 19, ♂.

HAB.—Southern Guinea.

5. DANURIA BUCHHOLZI, Gerstaecker.

*Danuria buchholzi*, Gerstaecker, Beitrag z. Kennt. Orthopt.-Fauna Guinea's 1883, p. 55, ♂.

HAB.—Akkra, Gold Coast.

## Genus 2. POPA, Stål.

*Popa*, Stål, Öfv. Kongl. Vet.-Akad. Förh. 1857, p. 169; 1871, p. 386; Bih. Kongl. Sv. Vet.-Akad. Handl. 1877, p. 70.

DISTRIBUTION.—South-African and Malagasy sub-regions of the Ethiopian Region.

## 6. POPA UNDATA, (Fabr.).

*Mantis undata*, Fabr., Ent. Syst. 1793, t. ii, p. 19, no. 28, ♀.—Charpentier, Orthopt. Desc. et Depict. 1841, tab. 38, ♂ ♀.

*Theoclytus ? undata*, Serville, Hist. Nat. d. Orthopt. 1839, p. 152, ♀.

*Popa spurca*, Stål, Öfv. Kongl. Vet.-Akad. Förh. 1857, p. 189; et 1872, p. 387, ♂.

*Popa undata*, Bates, P. Z. S. 1863, p. 473.—Saussure, Mém. Orthopt. 1872, t. ii, p. 79, ♀ (redesc.).

Two males differ from seven females from British Caffraria, and agree with a very large (63 mm. long) male from Delagoa Bay, in the Indian Museum, in the absence of lobes in the posterior legs, the sole character upon which *P. spurca* is founded by Stål, who was acquainted only with the male sex, of which lobeless hindlegs would appear to be a very usual, if not an invariable, peculiarity.

Bates had already united these two supposed species.

HAB.—Cape of Good Hope (*Charpentier*, *Serville*); Natal (*Stål*, *Bates*); South Africa (*Saussure*); Bedford, British Caffraria; Delagoa Bay; Madagascoar (*Bates*).

## Genus 3. HETEROCHÆTA, Westwood.

♂ ♀. Body greatly elongated, bacilliform, without foliaceous lobes and spines.

Head between the points of the sharp conical corneal spines nearly twice as wide as the pronotum at its dilatation; vertex concave, its median and sub-median lobes lower than its extensive lateral lobes, which with the eyes are bent forwards at obtuse angles to the rest of the vertex.

Organs of flight coloured: tegmina with the marginal field irregularly reticulate, the anterior radial forked just before the apical fourth, the posterior radial simple, the anterior prong of anterior ulnar simple, the posterior 4-branched, the dividens anastomosed with the posterior ulnar just before the posterior margin, and the plicate vein reaching the margin, but sending its three or four branches through the anal gusset, which is hence venose: wings with the anterior area narrow and the anterior ulnar simple and unbranched.

Forelegs: coxæ obclavate, with the inner crest armed at base with lobate saw-like teeth; femora narrow, sinuous above, weakly arched below, where they are armed on the outer edge, with 5 very long and sharp spines, on the inner edge with 13 alternately shorter and longer, and on the disk with 4. Posterior legs without foliaceous lobes, but furnished with genicular spines; tibiæ slightly thickened fusiformly, five-crested; 1st tarsal joint hardly longer than the two next together.

DISTRIBUTION.—East-African sub-region of the Ethiopian Region.

#### 7. *HETEROCHÆTA TENUIPES*, Westwood.

*Tomodera tenuipes*, Westwood, Ann. Nat. Hist. 1842, vol. viii, p. 272.

*Tomodera (Heterochæta) tenuipes*, Westw. Arc. Entom. 1842, vol. i, p. 163, pl.

41, ♀.—

*Heterochæta tenuipes*, Gerstaecker, Beit. z. Kennt. Orthopt.-Fauna Guinea's 1883, p. 56, ♀ et ♂ nymph.

HAB.—West and East-Africa: Senegal (*Westwood*); Bagamojo, Zanzibar mainland (*Gerstaecker*).

#### Genus 4. *HETEROCHÆTULA*, nov.

♂ ♀. Sexes alike. Body small, delicate, long, slender, bacilliform.

Head transverse, depressed, nearly horizontal, pentagonal; vertex much produced above the level of the eyes, distinctly divided by notches and grooves into five lobes, a median, two sub-median, and two lateral, the median with the inner parts of the sub-median forming the upper, the outer parts of the sub-median and the lateral with the eyes to the corneal spines on each side, the two superolateral, and the corneal spines to the labrum on each side, the two infero-lateral sides of the pentagon; middle of vertex concave or convex or level according as the median lobe or the sub-median lobes are the higher or all are of equal height; eyes compressed, laterally very salient, with a short simple or a bifid non-faceted corneal spine at the upper and outer angle; facial shield a transverse band deeply indented by the antennæ and not very distinctly defined basally, and concave apically; a small tubercle between the antennal scrobe and the eye on each side homologous with the curved ridge in *Toxodera*.

Pronotum transversely convex, transversed from the base to beyond the middle of the anterior lobe by a fine raised median line, which at the apex of the posterior and throughout in the anterior lobe is lodged in a shallow groove; its deflexed sides very finely toothed and its disk very minutely and sparsely granulose.

Terminal tergum of the abdomen transverse, truncated at the extremity. Cerci short, broadly foliaceous.

Organs of flight coloured. Tegmina: the veinlets of the marginal field long and very oblique and rarely branched and anastomosed so as to form a reticulum with very long and narrow meshes, posterior radial simple, anterior prong of anterior ulnar ♂ 2-branched, ♀ 1-branched; posterior prong ♂ 2-branched, ♀ 3-branched, dividens not quite reaching the margin, plicate vein reaching the margin, but sending its two branches through the anal gusset, which is hence venose, all the veins straight and much more oblique than in the preceding genus. Wings with the anterior area narrow and the anterior ulnar simple.

Forelegs of the same proportions as in the preceding; the coxæ above depressed and unarmed; femora armed below on the outer edge with 4 spines (order of length 2, 1, 3, 4), on the inner edge with 13 or 14 alternately shorter and longer (up to the 10th, which is followed by 2 or 3 short ones, the series being completed in each case by one which is somewhat longer than any of the rest), and on the disk with 4; tibiæ blunt roof-shaped. Posterior legs without foliaceous lobes, but provided with genicular spines; lateral genicular lobes of feebly 4-cristate femora short or acuminate produced; tibiæ filiform, terete above, feebly bi-cristate below; 1st joint of tarsus not longer than the next two taken together.

DISTRIBUTION.—Indian sub-region of the Oriental Region.

#### 8. *HETEROCHÆTULA TRICOLOR*, W.-M.

*Heterochæta tricolor*, Wood-Mason, Ann. & Mag. Nat. Hist. 1876, vol. xviii, ser. 4, p. 441, ♀.

HAB.—♀, Calcutta, Bengal (*type*); ♂ ♀, Khurda, Orissa (*var.*).

#### 9. *HETEROCHÆIULA FISSISPINIS*, n. sp.

Ripe Nymph. Corneal spines bifid. Submedian lobes of vertex conically or triangularly prolonged above the median so as to form an occipital concavity for the reception of the rounded anterior end of the pronotum. Anterior femora triangularly produced in the mid dorsal line over the knee joint, with the last long spine of their lower and inner margin preceded by three shorter ones. Lateral genicular lobes of the four posterior femora acuminate produced, especially in the anterior pair, in which they are twice the length of those of the posterior pair. Tip of abdomen broken off.

Length of pronotum 14 millims., of which the anterior and posterior lobes are respectively 3.75 and 10.25; of anterior coxa 6.66, femur 8.

HAB.—Bangalore, Mysore.

Genus 5. *ÆTHALOCROA*, W.-M.

*Æthalochroa*, Wood-Mason, Ann. & Mag. Nat. Hist. 1877, vol. xix, ser. 4, p. 808, ♂ ♀.

*Arsacia*, Stål, Bih. Sv. Kongl. Vet.-Akad. Handl. 1877, Bd. iv, No. 10, p. 70, ♀.

♂ ♀. Sexes alike. Body greatly elongated, bacilliform.

Head of moderate size, not wider than the 'dilatation' of the pronotum; occiput concave; vertex divided by grooves into five lobes, two lateral, which are always conoidally produced or swollen, two sub-median, which may or may not be produced, and one median forming a horizontal transversely convex elevation of considerable antero-posterior extent which widens slightly to its abrupt termination immediately above and behind the stemmata in a vertical flat area with a semicircular or symmetrically sinuous prominent margin, which appears to coincide with the forks of the epicranial suture and 'may or may not be produced in the middle line' into a horn, which may be simple or bifid; furnished at the ocular margins of the forehead with a small spine-like tubercle and lower down at the same margin with a faint wrinkle, on each side; eyes higher than broad, strongly prominulous, tumid, and furnished at the upper and outer angle, or at the junction of the upper and the lateral parts of their contour, with a conical non-faceted spine or at least with a minute round flat smooth tubercle; stemmata large on a three-way tubercle; facial shield pentagonal with its basal angle obtuse and somewhat projecting; clypeus with a strong mesially interrupted sub-apical transverse ridge; labrum convex; antennæ setaceous, much shorter than the prothorax.

Prothorax granulose: pronotum greatly elongated, steeply roof-shaped as to its slightly bowed posterior lobe, with the top of the ridge surmounted in the female by a prominent raised median dorsal line extending into the anterior lobe, which dorsal line is present in the male only for a short distance from the two ends of the pronotum; gradually widening from the dilatation to either end.

2-6 sterna of abdomen with a short sharp carina ending in a point at the middle of their hinder margin, ♂ 7-8 sterna emarginate at the extremity; terga with a raised median line which is produced to a point at the hinder end and increases, the point concomitantly decreasing, in strength to the extremity of the abdomen; 10th tergum flatly roof-shaped, short, about twice as broad as long, rounded at the extremity. Cerci broadly foliaceous, spatulate, rounded or truncate-rounded at the extremity.

Organs of flight when closed hardly extending beyond the apex of the fifth abdominal segment; their marginal fields subcoriaceous, semiopaque, the rest of the tegmina membranous, ♀ semi-transparent,

♂ hyaline, the rest of the wings membranous, ♀ hyaline or at most obsoletely tessellated, ♀ more or less distinctly and extensively tessellated with pellucid brown: longitudinal veins of tegmina very slightly and widely sinuous, almost straight; anterior radial forked at or just before its apical third, posterior radial simple, anastomosed to the anterior for a short distance soon after its origin, becoming again free at the stigma, which is indistinct, colourless, and in the radio-ulnar interspace; anterior prong of anterior ulnar 1 or 2-branched, posterior prong 4 to 5-branched; *dividens* running to posterior margin or into posterior ulnar; *plicata* sending its main stem direct to the margin, its branches through the anal gusset, which is hence venose; and the transverse veinlets curved: wings with distinct anal emargination, unbranched anterior ulnar, and first plicate vein forked at or before the end of its basal third.

Anterior coxæ triquetrous, their crests, especially the posterior, granulose-spinulose, the anterior or upper expanded at the apex into a short foliaceous lobe; femora with their upper margin concave, cristate at the apex, their lower armed on the outer edge with 5 spines, of which the first two are sub-equal and longer and the last three sub-equal and shorter, on the inner edge with 12-14 alternately shorter and longer, of which the two last are long ones, and on the disk with 3 small ones; tibiae weak, curved, slightly enlarged to either end from their thin middle, but especially to the armed end, terete above to within a little of the apex, which is faintly crested, paucispinose, being armed only on the apical fifth of their outer edge and on the apical half of their inner edge, terminal claw long and rather abruptly hooked.

Posterior legs rather short, strongly crested; femora prismatic, without genicular spines, with four crests, which may or may not be expanded into foliaceous lobes and in the latter case are spinulose, their knee-lobes short, submucronate-triangular; tibiae triquetrous, equal to or a trifle longer than the femora, with three crests, one dorsal and two ventral, with or without foliaceous lobes, in which latter case they are 5-sided and fusiformly enlarged; first tarsal joint short, only about as long as the two following taken together.

DISTRIBUTION.—Indian and [South Indian and]\* Ceylonese subregions of the Oriental Region.

The discovery of two species with well-developed corneal spines has led to the detection of vestiges of those structures in the typical species.

\* The brackets are intended to indicate that no representative of the genus has yet been recorded from the portion of the subregion the name of which is enclosed.

10. *ÆTHALOCHROA ASHMOLIANA*, (Westw.)

*Yates ashmolianus*, Westw., Ann. Nat. Hist. 1842, vol. viii, p. 272; Arcana Entomol. 1843, vol. ii, p. (note †) ♀.

*Æthalachroa ashmolia*, Wood-Mason, Ann. & Mag. Nat. Hist. 1877, vol. xix, ser. 4, p. 308, ♂ ♀.—P. Z. S. 1878, p. 584.

*Arsacia ashmolia*, Stål, Bih. Sv. Vet.-Akad. Hand. 1877, Bd. iv, no. 10, p. 75, ♀.

♂ ♀. Margin of anterior end of median lobe of vertex bisinuous with a minute blunt projection on each side of the middle line. Eyes with a minute, slightly convex circular non-faceted spot or tubercle representing a corneal spine.

Tegmina: a finger-print-like mark at the base forming a curved band across the closed organs of flight, a marbling along the marginal field, and some short streaks on the longitudinal veins—deep rich brown, and some obscure brown blotches on the membrane, which in the ♀ is clouded with greyish whity-brown, but in the male is almost perfectly hyaline; the anterior and posterior prongs of the anterior ulnar are respectively 1- and 4-branched; the dividers runs to the posterior margin.

Wings: ♂ the anterior margin and apex marbled with dark brown and the rest hyaline: ♀ the anterior margin and apex more extensively and deeply marbled with dark brown; a tessellated pellucid violet-fuscon blotch of greater or less extent near the base of the posterior area, which is followed by broken and anastomosed concentric waves of the same colour, and also of varying extent and intensity, extending between the seventh plicate vein and the anterior margin to the outer margin, and, when less developed, leaving an ante-apical roundish patch of sub-hyaline in the anterior area.

Four posterior femora with three sub-triangular foliaceous lobes near the apex, one on the upper or posterior of the dorsal crests, and two on the two ventral crests, all arched proximally and sub-dentate distally; tibiae with one foliaceous lobe extending from the knees to the middle of the joint on its dorsal crest and with their two ventral crests foliaceously expanded throughout increasingly from the base, so much so in a female from Ceylon that the joint when viewed from below has a long spatulate outline.

Total length, ♂ 100, ♀ 115 millims.; length of pronotum ♂ 33, ♀ 40, of which the anterior and posterior lobes are respectively, ♂ 7.6, ♀ 9.5 and ♂ 25.4, ♀ 30.5; width of prothorax at supracoxal dilatation, ♂ 4.5, ♀ 5.6, at hinder extremity, ♂ 3.6, ♀ 4.5; length of abdomen, ♂ 46, ♀ 52, width at middle, ♂ 35, ♀ 5; length of tegmina, ♂ 45, ♀ 55, width at middle, ♂ 9, ♀ 11, near base ♂, 11 ♀ 12.5; length of wings, ♂ 42, ♀ 52, breadth ♂ 22.5, ♀ 27; length of fore coxa,

♂ 15, ♀ 16·5; femur, ♂ 16·5, ♀ 19·75, breadth at angulation ♂ 2, ♀ 3; tibia, from base to insertion of tarsus, ♂ 12, ♀ 15; of immediate femur, ♂ 12·5, ♀ 15·5; tibia, ♂ 12·5, ♀ 15·5; of posterior femur, ♂ 15, ♀ 19; tibia, ♂ 15, ♀ 19; of antennæ, ♂ 23, ♀ 18; of cerci, ♂ 7·5, ♀ 8·5; width ♂ 2, ♀ 2·6.

HAB.—Bombay (var. *simplicipes*); Calcutta, Berhampur, and Jalpiguri, Bengal; "N. India" (var. *insignis*); Ellore, Godavery District, Madras Presidency (*Sir Walter Elliott's drawings*); Colombo, Ceylon.

#### 11. *ÆTHALOCHROA AFFINIS*, n. sp.

♂. Anterior end of median lobe of vertex produced upwards in the middle line into a small blunt spine or tubercle. Eyes with a sharp regularly conical non-faceted corneal spine.

Organs of flight coloured as in the preceding. In the tegmina the anterior and posterior prongs of the anterior ulnar are 2- and 4-branched respectively and the divdens is anastomosed with the posterior ulnar.

Legs as in the preceding. Fore tibiæ with 4-5 spines outside and 7-8 inside.

Total length 78·5 millims.; length of pronotum 26, of which the anterior and posterior lobes are respectively 6 and 20, breadth at supra-coxal dilatation 4, at hinder end 3·25; length of meso- and metanotum with seg. med. 14; of abdomen without seg. med. 38, breadth at middle 4; length of tegmina 36·5, breadth near base 9, at middle 7; length of wings 35, breadth 20; length of fore coxa 11, femur 14, breadth at angulation 3, length of tibia, from base to insertion of tarsus, 10; of intermediate femur 9, tibia 9; of posterior femur 11, tibia 11; of antennæ (broken); of cerci 5·5, breadth 1·75.

HAB.—Sind.

#### 12. *ÆTHALOCHROA SPINIPES*, n. sp.

♂. The lateral and sub-median lobes of the vertex are more pointed than in the preceding and the anterior end of the median lobe is produced upwards into a bifid process. The eyes bear a blunt conical, almost finger-shaped, corneal spine. Antennæ greyish whity-brown.

The organs of flight are almost perfectly pellucid and almost colourless throughout, only the marginal field of both pairs being slightly opaque and obsoletely mottled with brownish, and the posterior area of the posterior pair presenting faint vestiges of the basal blotch with succeeding waves of amethystine fuscous which forms so conspicuous a feature in the female of the typical species. In the tegmina the anterior and posterior prongs of the anterior ulnar are respectively 2- and 5-branched and the divdens is anastomosed with the posterior ulnar.



The fore tibiæ 4-spined outside and 7-spined inside; the last spine on each side more oblique than the rest. The posterior legs bear no foliaceous lobes: the femora are all armed on each of their two ventral crests with six small spines, so that the spines of the one crest are opposite to those of the other, and the four mean spines subequal and larger than the two extreme in each case; the tibiæ are fusiformly thickened, five-sided, bearing five crests, one double dorsal, two lateral, and two spinulose ventral, the intervals between which are transversely nearly level.

Total length 73 millims.; length of pronotum 23, of which the anterior and posterior lobes are respectively 5 and 18, breadth at dilatation 3, at hinder end 3; length of meso- and metanotum with seg. med. 11·5; of abdomen without seg. med. 33·5, breadth at middle 2·5; length of tegmina 31, breadth near base 7·5, at middle 6; length of wings 32, breadth 16·5; length of fore coxa 10, femur 11·5, breadth at angulation 2, length of tibia, from base to insertion of tarsus, 8; of intermediate femur 7, tibia 7·25; of posterior femur 9·75, tibia 10; of antennæ 16; of cerci 5·25, breadth 1·65.

HAB.—Karachi, Sind.

#### Genus 6. PARADANURIA, W.-M.

*Paradanuria*, Wood-Mason, Ann. & Mag. Nat. Hist. 1877, vol. xix, ser. 4, p. 220, ♀ nymph.

♀ (nymph). Body elongated, small and delicate, slender bacilli-form. Integument granulose and longitudinally coarsely paucirugose.

Head depressed, thin, horizontal, higher or rather longer than broad, rather broader than the prothorax at its dilatation, with vertex, forehead, and face in the same plane; vertex with its lateral lobes produced above and slightly outwards over the eyes to a blunt tubercle, so as to form an occipital concavity for the reception of the rounded fore end of the pronotum, its median lobe on the disk elevated into a huge convex boss, which is roundly prominent posteriorly or superiorly, appearing in a front view to project above the concave occipital line, and is separated anteriorly or inferiorly by a transverse groove from the subquadrate stemmatal eminence, which bears a blunt conical tubercle at the middle of its posterior margin. Eyes narrow, wall-sided, with the upper part of their contour at right angles to the lateral and a short stout bluntly mammilliform non-faceted corneal spine at the angle.

Pronotum roof-shaped with distinct rounded dilatation, and a raised dorsal line, which is continued to the extremity of the abdomen.

Terminal tergum of abdomen triangular with arched sides. Cerci foliaceous extending by fully  $\frac{2}{3}$  of their length beyond the extremity of

the 7th sternum, equalling in length the four terminal abdominal terga taken together, and widening from the base to the apex, which is divided by a shallow notch into two points.

Anterior legs long and slender; coxæ expanded along the apical fourth of their anterior crest into a conspicuous dentate foliaceous lobe; femora nearly straight above, weakly arched below, with acute genicular lobes and a conspicuous supra-genicular lobe at obtuse angles to the upper margin, armed below on the outer edge with 6 spines, of which the first is equal to the third and the 2nd to the 6th form a slightly decreasing series, on the inner edge with 12 alternately shorter and longer, and on the disk with 3; tibiæ as broad as high, above terete, perfectly straight and uniformly wide throughout from base to insertion of tarsus. Posterior legs very short; the femora stout, slightly tapering at both ends, prismatic, with four strong crests, a blunt ridge on each side between the dorsal and ventral crests, the upper or posterior of the ventral crests foliaceous, long slender genicular and supragenicular lobes, but no genicular spines; tibiæ rather longer than the femora, above terete, below bicristate; 1st joint of tarsus not quite so long as the three succeeding taken together.

DISTRIBUTION.—Indian sub-region of the Oriental Region.

Winged specimens of this genus will be described and figured by Professor Westwood in his forthcoming '*Revisio Mantidarum*.'

### 13. PARADANURIA 'ORIENTALIS, W.-M.

*Paradanuria orientalis*, Wood-Mason, Ann. & Mag. Nat. Hist. 1877, vol. xix, ser. 4, p. 220, ♀ nymph.

HAB.—Bangalore, Mysore.

### Genus 7. EUTHYPHLEPS, nov.

♀. Body long, rather small and delicate, slender bacilliform. Integument granulose and spinulose especially in the prothorax.

Head somewhat depressed; vertex slightly declivous, its median lobe separated from the submedian lobes by two longitudinal depressions of the disk, the latter triangularly produced backwards, upwards, and outwards so as to form an occipital cavity for the reception of the fore end of the pronotum; forehead and face convexly more declivous, so that, when the head is viewed from the side, the eyes appear to be separated from the submedian lobes of the vertex by a deep notch one side of which is formed by the eyes, the other by the submedian lobes, and the bottom by the narrow lateral lobes of the vertex. Stemmata large, on a considerable eminence, which bears a

spike-like erect tooth at the middle of its hinder margin, and is separated off from the vertex by a transverse groove. Eyes narrow, oval, convex laterally, produced above the level of the lateral lobes of the vertex, armed at the upper and outer angle with a large stout blunt somewhat curved finger-shaped non-faceted corneal spine.

Pronotum roof-shaped with transversely convex sides, surmounted by a raised dorsal line, which is continued to the extremity of the abdomen.

Abdominal sterna produced in the middle of their hinder margin; terga 1-7 produced in the middle posteriorly to a delicate filamentous process, the last a broadly concave-truncate triangle with the sides arched. Cerci broadly foliaceous, 13-jointed, broadest at the antepenultimate joint, reaching but little beyond the 7th sternum, the upper apex of their last four joints produced so that their upper margin is bluntly dentate and their apex bifid.

Organs of flight extending nearly to the extremity of the abdomen. Tegmina semiopaque, sub-coriaceous, parallel-sided; the marginal field irregularly reticulate; the longitudinal veins of anterior area nearly parallel to the margins with their interspaces narrow and divided by false veins; the posterior area and its gusset produced, with its longitudinal veins very oblique; the anterior prong of anterior ulnar simple and unbranched, posterior prong 6-branched; the dividens anastomoses with the posterior ulnar some distance before the margin, the 4-branched plicata goes to the margin, its 1st and 2nd branches running parallel with it, but dissolving into a common reticulum at varying distances from the margin, and its 3rd and 4th traversing the anal gusset, which is hence venose. Wings hyaline except in the anterior margin and apex; apex blunt not extending far beyond that of the posterior area; anal emargination slight, obtuse-angular; anterior ulnar forked at about the junction of second and apical thirds of its length.

Fore-legs long and slender; coxæ expanded for fully the apical third of their anterior crest into a conspicuous dentate foliaceous lobe; femora narrow, slightly sinuous above, that is to say, faintly convex basally and then shallowly concave to the apex, which is produced, as in the preceding genus, forwards and upwards over the femoro-tibial articulation into a supragenicular spine, below weakly arched at base, armed on the straight outer edge with 5 spines, on the inner with 11, and on the disk with 3; tibiæ straight, paucispinose, terete above. Posterior legs similar but longer and slenderer than in the preceding genus, and furnished with curved acicular genicular spines longer than the genicular lobes, the lateral ones of which are longer than the dorsal.

DISTRIBUTION.—Himalo-[Chinese] subregion of the Oriental Region.

14. *EUTHYPHELEPS RECTIVENIS*, n. sp.

♀. Body the colour of a dead twig.

Tegmina semitransparent pale yellowish brown with the marginal field and a long linear streak on the basal half of the anterior prong of the anterior ulnar opaque bright cinnamon-brown. Wings hyaline with the anterior margin semitransparent pale yellowish brown and a decreasing series of four or five streaks on the veins at the apex cinnamon brown.

Fore tibiae armed on the outer edges with 4-4 and on the inner with 6-7 spines, the last of which is strongly directed obliquely towards the apex.

Posterior legs with a slight lobe on the upper or posterior dorsal crest and a well developed one on the upper or posterior ventral crest, which is divided, by a more (posterior pair) or less (intermediate pair) distinct emargination, into two lobes, a smaller trilobulated proximal and a larger crescent-shaped obsoletely dentate distal.

Total length 70 millims ; length of pronotum 19·5, of which the anterior and posterior lobes are respectively 4·25 and 15·25, breadth at supracoal dilatation 3·25 ; length of meso- and metanotum with seg. med. 13 ; of abdomen without seg. med. 33, breadth at middle 2·75 ; length of tegmina 43, breadth at middle 7 ; length of wings 39, breadth 17 ; length of fore coxa 10, femur 16, breadth 1·75, length of tibia, from base to insertion of tarsus, 11 ; of intermediate femur 10, tibia 10·25 ; of posterior femur 12, tibia 14 ; of antennæ 19 ; of cerci 3·5, breadth 2.

HAB.—Kulu, Kangra, N.-W. Himalayas, 3,600 feet (*A. Graham Young*).

Genus 8. *TOXODEROPSIS*, nov.

♂ ♀. Body greatly elongated, bacilliform.

Head similar to that of the genera *Toxodera* and *Paratoxodera*, but not nearly so wide, its long axis forming with that of the eyes a much narrower angle ; median and submedian lobes of the vertex a little higher than the lateral lobes, slightly arched, separated by a transverse groove from the prominent eminence which bears the large stemmata, and is produced at the middle of its upper or hinder margin into a short erect process, which may be acute or blunt and sub-bifid ; eyes oval, convex, produced slightly above the level of the lateral lobes of the vertex, and bearing at their upper and outer angles a long sharp slender incurved conical non-faceted corneal spine ; a small tubercle close to the inner and anterior margin of each eye, representing the curved ridge in *Toxodera* ; facial shield divided into three parts, one

median prominent semicircular below and between the antennæ, and two lateral sunken subquadrate, between which and the eyes a very narrow space intervenes.

Prothorax subrugose, and roughly granulose, especially on the edges of the pronotum, much elongated, but shorter than in *Toxodera* and *Paratoxodera*, being not quite equal in length to the basal  $3\frac{1}{2}$  segments of the abdomen exclusive of seg. med., quite straight from end to end; the posterior lobe of its pronotum less steeply roof-shaped with the sides slightly convex transversely and the ridge line, which is distinctly compressed, especially in front, very sharp, and feebly arched longitudinally; the anterior lobe with a raised median line lodged in a shallow furrow, enlarged at the extremity in ♂, as in *Æthalochroa*.

Abdomen smooth and polished, without foliaceous lobes, subparallel-sided, very slightly and gradually widening, and bluntly carinate above, from the base of the 4th to the apex of its 6th segment, thence narrowing more rapidly to its extremity, the last four segments forming a carinated roof-shaped mass with serrated sides; terga 1-6 with a notch accompanied by a very small and delicate filamentous process at the middle of the hinder margin; sterna with the posterior margin arcuately prominent, subcarinate, but without foliaceous duplicatures of the integument, in the middle line at hinder end; 10th tergum triangular a little broader than long. Cerci foliaceous, lanceolate, acutely bifid, as in *Toxodera*.

Organs of flight in shape and structure very similar to those of *Toxodera*, both pairs having the apex anterior, and the tegmina, the interspace between the posterior radial and the anterior prong of the anterior ulnar wide and multicellular. In the tegmina, the marginal field is opaque and only moderately wide, irregularly and strongly reticulate the stigma, which is long and linear, lies as obliquely as possible upon the posterior radial, extending a very short distance into the interspace on each side of the vein; the anterior prong of the anterior ulnar, like the posterior radial, simple, the posterior prong being 3 or 4-branched; the dividens anastomoses with the posterior ulnar, and may or may not give off an anterior branch which does not do so; the plicata runs either direct, or after anastomosis with the posterior ulnar, to the posterior margin, but in either case sends all its branches through the anal gusset, which is hence venose. In the wings there is a distinct anal emargination and a simple and unbranched anterior ulnar.

Anterior legs long and slender; coxæ with the anterior crest for the apical two-fifths of its length expanded into a conspicuous dentate foliaceous lobe; femora narrow, above nearly straight and carinate, the carina ending in a sharp supra-genicular lobe somewhat

longer than the lateral lobes, also almost straight below, where they are armed on the outer edge with 5 or 6 spines, on the inner edge with 11, and on the disk with 3; tibiae straight, terete above, paucispinose, the spines in a single short series decreasing from the apex.

Posterior legs short and weak; femora prismatic, slightly tapering to both ends, with four strong crests and a strong blunt crooked ridge on each side giving them the appearance of being bent down near the apex, with three equal acuminate genicular lobes and an acicular genicular spine, which is longer than the lobes in the anterior pair, with the two dorsal crests slightly lobed and the upper or posterior ventral crest expanded into a foliaceous lobe, which is divided into two or more lobules; tibiae longer than the femora, terete above, (?) obsoletely bicristate below; first tarsal joint shorter than the two succeeding joints taken together.

DISTRIBUTION.—Indian sub-region of the Oriental Region.

This genus is closely allied to *Toxodera* and *Paratoxodera*, agreeing with both, amongst other things, in the oblique truncation of the extremities, resulting in the forward position of the apices, of the organs of flight, and with the former, but not with the latter, in the radio-ulnar cell of its tegmina being wide and multicellular, and in the anal cerci being lanceolate and acutely bifid at the extremity; but it may be distinguished readily from both by the possession of a distinct though small frontal horn foliaceously amplified fore coxae, paucispinose fore tibiae, with the spines of each side in a single short and decreasing series, 6-spined fore femora, a short first joint to its four posterior tarsi, a simple and unlobed abdomen, a straight pronotal long axis, and a venose anal gusset to its tegmina.

15. *TOXODEROPSIS SPINIGERA*, n. sp., Westw. & W.-M.

*Toxodera spinigera*, Westwood, MSS

♀. Dark vandyko-brown the colour of a dead twig or of rotten leaves.

The frontal horn is a sharp spike-like projection.

Tegmina with the marginal field opaque dark vandyke-brown, an opaque whity-brown longitudinal streak extending from the base to beyond the middle of the wing immediately posterior to the anterior radial, diffusing itself along each side of the veins of the disk, and including the long polished stigma and the base of the anterior radial, the anal area smeared with dark vandyko-brown, and the longitudinal veins marked with somewhat blurred and smear-like spots and streaks of the same colour, especially at the apex, where every vein has a streak at its extremity. The posterior fork of the anterior radial is distinctly 4-

branched on one side, indistinctly so on the other. The *dividens* gives off an anterior branch which is connected both with its own main stem and with the posterior ulnar, thus furnishing the only instance known to me in which this vein is branched. The main stem of the plicate runs to the posterior margin direct.

Wings pellucid, increasingly from the base very pale smoky-quartz-colour, with the opaque anterior margin, the longitudinal veins, and the very fine, though very distinct, transverse veinlets, all increasingly from the base, and with streaks on the apical ends of the veins of the anterior area, vandyke-brown.

The fore femora, which have three pale rings especially well marked on the inner and under sides, are armed below on the outer edge with 6 spines and on the inner with 11; and the tibiae with 3 on the outer edge and 7 on the inner edge.

The dorsal crests of the four posterior femora are slightly produced triangularly opposite to the bend in the lateral ridges; and the upper or posterior ventral foliaceous lobe is divided by a narrow rounded emargination into two lobules, one much smaller and proximal, the other much larger and distal, which are again subdivided by angular notches into two obliquely pointed lobes.

The upper angle of the penultimate joint of the cerci though acute is not produced.

Total length 93 millims.; height of head 4, breadth between the points of the corneal spines 6·75, length of corneal spines 1·25; of pronotum 28·75, of which the anterior and posterior lobes are respectively 5·75 and 23, breadth at supracoxal dilatation 4, at hinder end 4·25; length of meso- and metanotum with seg. med. 16; length of abdomen without seg. med. 47, breadth at middle of 4th seg. 4, at apex of 6th seg. 6·25; length of tegmina 47·5, breadth at middle 8·25; length of wings 42·5, breadth 19; length of fore coxa 14·5, femora 19·5, breadth 2; length of tibia from base to insertion of tarsus 13; of intermediate femur 7·5, tibia 9·5, 1st tarsal joint 2; of posterior femur 8·25, tibia 11, 1st tarsal joint 2·25; of antennæ (absent); of cerci 8, breadth 2.

HAB.—Bombay.

#### 16. *TOXODEROPSIS TAURUS*, n. sp.

♂ ♀. Smaller. Colouring the same.

The frontal horn is truncate and in the female distinct bifid.

In the tegmina the main stem of the plicate runs to the margin after anastomosis with the *dividens*, which is simple and unbranched.

The fore femora are armed below with ♀ 5—5, ♂ 5—6 spines only on the outer edge and with ♀ 10—11, ♂ 11—11 on the inner; and the

tibiæ with ♂ ♀ 4—4 on the outer edge and ♀ 7—8, ♂ 6—7 on the inner.

In the posterior femora, the upper or posterior dorsal crest bears two or three saw-like teeth and the distal lobule of the ventral foliaceous lobe is divided right to its base and has a minute sharp spinule in front of it, of which but slight traces are to be seen in the other species.

The upper angle of the penultimate joint of the cerci is as much produced and as sharp as the tips of the terminal.

Total length ♂ 78, ♀ 88 millims.; length of pronotum, ♂ 21·5, ♀ 26·5, of which the anterior and posterior lobes are respectively ♂ 4·5, ♀ 5·75 and ♂ 17, ♀ 20·75, breadth at supra-coxal dilatation ♂ 3·5, ♀ 4, at hinder end ♂ 3·5, ♀ 4; length of meso- and metanotum with seg. med. ♂ 15·5, ♀ 16; length of abdomen without seg. med. ♂ 39, ♀ 42, breadth at middle of 4th seg. ♂ 2·75, ♀ 3·5, at apex of 6th ♂ 4·5, ♀ 6; length of tegmina ♂ 37, ♀ 44, breadth at middle ♂ —, ♀ 7·5; length of wings ♂ 36, ♀ 40, breadth ♂ — ♀ —; length of fore femur ♂ 15·5, ♀ 18, tibia, from base to insertion of tarsus, ♂ 10, ♀ 12; length of intermediate femur ♂ — ♀ 7·25, tibia ♂ — ♀ 10·25, 1st tarsal joint ♂ — ♀ 2; of posterior femur ♂ — ♀ 8·5 tibia ♂ — ♀ 11, 1st tarsal joint ♂ — ♀ 2·75; of cerci ♂ (broken off), ♀ 6·25, breadth ♀ 2.

HAB.—♂ Sind; ♀ Khurda, Orissa (*W. C. Taylor*).

The two succeeding genera differ from all the preceding in having the fore tibiæ multispinose on both edges, with the spines of both edges divided at irregular intervals into several irregular series by some of their number being longer and stouter than the others, and in having a long first joint to their four posterior tarsi, and from all except *Heterochæta* and *Heterochætula* in not having the upper crest of the fore coxæ in the slightest degree foliaceously amplified at the apex.

#### Genus 9. TOXODERA, Serville.

*Toxodera*, Serville, Ann. Soc. Ent. Fr., 1837, t. vi, p. 27.—Hist. nat. d. Orthopt. 1839, p. 168, ♂.

♂ ♀. Sexes alike. Body greatly elongated, bacilliform.

Head broad, triangular; vertex between the eyes regularly arched, divided by two broad and shallow discal impressions into a median and two submedian lobes, which are separated from the unarmed stemmatal eminence by a transverse groove, and the two latter of which are limited off by fine grooves from the ample lateral lobes, which, with the eyes, are almost in the same plane with the rest of the vertex, being scarcely at all bent forwards; a strong ridge curves inwards and upwards on each side from a point at the ocular margin which is opposite to the



anterior margin of the antennal scrobe to the ends of the epicranial suture and is so directed at its upper end that it would if continued far enough pass into the groove which separates the lateral from the submedian lobes of the vertex; the facial shield has not shared in the widening of the head, a wide space intervening between it and the eyes; it may be described as a transversely elongated rectangular plate giving off a broad tongue-shaped process from its upper or basal margin, or as a broad isosceles triangle the two adjacent equal sides of which are deeply indented by the antennal scrobes. The eyes are compressed and somewhat drawn out superolaterally, where they bear a huge straight slender conical non-faceted spine. Stemmata large on a prominent cuboidal frontal eminence.

Prothorax very greatly elongated, as long as the abdomen to the middle of the sixth segment. Pronotum with its lateral margins granulose, becoming spinulose in front, deflexed in the posterior, nearly horizontal in the anterior lobe, which is bent up at an obtuse angle to the posterior lobe, is transversely convex, bears a few tubercles on each side of the middle line, and presents on its posterior enlarged end a broad and shallow longitudinal depression, which is continuous with a similar one on the enlarged anterior end of the posterior lobe, which is higher than broad, so strongly compressed as to be very steeply roof-shaped, and, with the sternal region, so strongly arched as to have the form of a bow, being concave ventrally and correspondingly convex dorsally, where it is surmounted by a blunt rather ill-defined raised line, on which, especially anteriorly, where some are collected into a small clump deforming the surface, are a few small mammilliform tubercles, and which at the ♀ broadly truncate-rotundate, ♂ triangularly produced (?), posterior end gives off a very narrow spirally coiled leathery process.

Mesonotum, metanotum, and seg. med. with a very strong raised dorsal line, which is continued decreasingly to the end of the 4th abdominal tergum, where it ends to begin again at the anterior end of the fifth tergum to be continued increasingly to the last.

The abdomen is of uniform width to the 6th segment, thence tapering in slightly arched outlines to its rounded extremity; all its terga bear in the middle line posteriorly a fringed cup-shaped foliaceous lobe the upper lip of which terminates in a delicate recurved filament, and which in the 5th and 6th is large, in the 5th very large, and conspicuous; ♀ sterna 2-6 with subequal foliaceous sub-quadrant-shaped duplicatures of the integument at middle of hinder margins; 10th tergum semioval, roof-shaped,  $1\frac{1}{2}$  times as broad as long. Cerci foliaceous, lanceolate, divided at the extremity by a deep notch into two sharp points, extending by more than two-thirds of their length beyond the abdomen.

Organs of flight equally well-developed in the two sexes, when closed, not quite reaching up to the foliaceous lobe of the 5th tergum, obliquely truncate at the extremity, so that the apex in both is subacute and falls just behind the anterior margin, and that there is no anal emargination in the hinder pair. All the longitudinal veins remarkably straight.

Tegmina with the marginal field tolerably expanded at base, irregularly reticulate, and semiopaque, the anterior radial forked at junction of outer and middle third and its upper prong running to the apex, the posterior radial simple, the stigma long and narrow placed as obliquely as possible across the radio-ulnar interspace and extended on to the two bounding veins, the anterior prong of the anterior ulnar forked, the cellules of the wide middle part of interspace between the anterior ulnar and the posterior radial in five transverse rows, the posterior prong of the anterior ulnar 2-branched, the dividens anastomosed with the posterior ulnar some distance short of the margin, the plicate, which all but reaches the posterior margin, broken up into a reticulum contributed to by its three branches, none of which enters the anal gusset, which is hence reticulate. Wings with the anterior ulnar simple.

Legs tolerably long and slender. Fore coxæ strongly triquetrous, spinulose on the front crest, rough on the others, the front and outer ones produced at apex to sharp rough spines; femora strongly curved, obclavate, strongly sinuous and carinate above and angulate-rounded near the base below, at the apex trispinose, armed on the outer edge of the lower margin with 6 spines, on the inner edge with 14, on the disk with 3; femoral brushes thick, on distinct eminences; tibiæ multi-spinose, the spines divided into several irregular series by long spines, the 1st, 8th, 12th, 16th, 19th, and 22nd of the inner edge, and the 1st, 5th, 7th, 9th, 11th, and 13th of the outer edge, being subequal and longer than any of those between them. Four posterior femora shorter than the tibiæ, 4-crested, with a ridge on each side, both dorsal crests and the posterior ventral crest furnished with large lobulated foliaceous lobes, lateral genicular lobes long, but only half the length of the curved supra-genicular lobe, which is equal in length to the acicular genicular spines, tibiæ filiform, terete, without a trace of a crest either above or below, their calcaria acicular; 1st joint of tarsus long, longer than the three following taken together.

DISTRIBUTION.—Malayan subregion of the Oriental Region.

#### 17. TOXODERA DENTICULATA, Serville.

*Toxodera denticulata*, Serville, op. et loc. supra cit. pp. 25 et 169, pl. ii, et pl. v, ♂.

♀. Differs only in its larger size, and, in having the tegmina a little more clouded with the brown blotches larger and deeper-coloured, and the posterior lobe of the pronotum more bowed.

The fore tibiæ are armed on the inside, right with 23 spines, of which the 1st, 8th, 12th, 16th, 19th and 22nd, left with 22, of which 1st, 7th, 11th, 15th, and 18th, the 7th short one being absent, and on the outside, right (malformed) with 10, of which 1st, 4th, and 7th, left with 13, of which 1st, 5th, 7th, 9th, 11th, and 13th, from the apex are subequal and stouter and longer than any of the rest.

Total length 150 millims.; height of head 7, breadth between ips of corneal spines 13·5, length of corneal spines 2·5; length of pronotum in a straight line 57, of which the anterior and posterior lobes are respectively 11·25 and 46, breadth at supra-coxal dilatation 7·25, at hinder end 6, at middle of posterior lobe 3·9; height at middle of posterior lobe 5·9; length of meso- and metanotum with seg. med. 23; of abdomen without seg. med. to end of ovipositor, 70, to end of 10th tegmina 66, breadth at middle of 4th segment 6·5, height of foliaceous lobe of 5th tergum 10, of 6th tergum 8; length of tegmina 67·5, breadth at middle 14, of marginal field 3·25; length of wings 60, breadth 31; length of fore coxa 22, femur 30, breadth at angulation 3, length of tibia, from base to insertion of tarsus, 22·25, 1st tarsal joint 6; of intermediate femur without genicular lobes 22·5, tibia 27·5, 1st tarsal joint 7; of posterior femur without genicular lobes 22, tibia 32, 1st tarsal joint 10, lateral genicular lobes 3, supra-genicular lobe 5, genicular spines 5, of antennæ 43; of cerci 14, breadth 3·5.

HAB.—Java.

#### Genus 10. PARATOXODERA, nov.

♀. Body greatly elongated, slender bacilliform.

Head much as in the preceding genus, but the lateral lobes of the vertex with the eyes distinctly bent forwards at an obtuse angle to the median and submedian lobes, and the facial shield broad triangular.

Prothorax also much as in the preceding, but the posterior lobe of its pronotum is straight; furnished in the mid dorsal line with three conspicuous equidistant thorn-like horns, the one basal thin and foliaceous springing entirely from the raised dorsal line, and the two others stout, rigid and hard, minutely bifid developed from the disk; and triangularly produced at its hinder end.

5th and 6th abdominal terga with large erect foliaceous lobes which do not end in a recurved filament; the preceding terga having only rudiments of lobes; sterna 3-4 with subequal quadrant-shaped foliaceous duplicatures of the integument at the hinder end. Cerci short, extending very little beyond the seventh sternum, broad pyriform in outline, their upper third bent outwards and downwards at an obtuse angle to the remainder.

The organs of flight do not reach beyond the end of the fourth abdominal tergum, but they are of much the same shape and structure, the chief differences being that in the tegmina the stigma is triangular and in the radio-ulnar interspace, extending on to the two bounding veins, the posterior prong of the anterior ulnar is 7-branched, the interspace between the anterior prong of this vein and the posterior radial is simple, not wide and multicellular, and the anal gusset is venose, being traversed by the posterior branch of the plicate; and that in the wings a slight anal emargination is present.

The crests of the fore coxæ are not produced at the apex; the femora and tibiæ are of similar shape and structure, but the former are 7-spined on the outside and 15—16-spined on the inside.

The four posterior legs are also similar, but the lateral genicular lobes are not acuminate produced, and the posterior calcaria of the tibiæ are foliaceous, lanceolate.

DISTRIBUTION.—The Malayan sub-region of the Oriental Region.

This genus is very closely allied to *Toxodera*, with which it agrees in the peculiar and remarkable character of the armature of the fore tibiæ, in the anterior lobe of the pronotum being tilted upwards at an obtuse angle to the posterior, and in having large erect and anteriorly buttressed foliaceous lobes at the hinder end of the 5th and 6th terga with rudiments of similar ones, which no doubt stood erect during the larval life of the animal, on all the preceding terga of the abdomen; but it differs therefrom, amongst other things, in having the fore femora 7-spined below on the outer edge, the posterior lobe of the pronotum quite straight and cornigerous, the radio-ulnar cell of the tegmina simple and similar to the other cells of the disk, the anal gusset of the tegmina venose, and the anal cerci very short and broad pyriform in outline, in characters, in fact, which, in my estimation, amply justify the foundation of a new genus.

#### 18. PARATOXODERA CORNICOLLIS, n. sp.

♀. Body and legs brown the colour of a twig, with the hinder end, including the foliaceous appendage which arises therefrom, whitish-brown.

Foliaceous horn at base of pronotum very strongly hooked and produced forwards, the second horn erect, divided transversely into two sharp points, and the third, which is inclined forwards and rather larger than the second, divided longitudinally into two points.

Marginal field of tegmina to anterior radial, which is thrice annulated with whitish-brown, and a large irregular triangular mottling

extending therefrom in the transverse direction nearly halfway across the discoidal area and in the longitudinal direction for about two-thirds of the distance between the stigma and the apex, opaque rich vandyke-brown, the rest of the organs semitransparent whity-brown with a touch of grey.

Anterior margin of wings semitranslucent whity-brown marbled, with the veins at the apex streaked, with vandyke-brown, the rest hyaline with the veins whity-brown.

Fore tibiæ armed on the inner edge with, right 32 spines, of which number the 1st, 8th, 14th, 19th, and 23rd, left 34, of which the 1st, 10th, 16th, 21st, 27th, and 29th, and on the outer edge with, right 18 spines, of which the 1st, 8th, 12th, and 16th, left 19, of which the 1st, 8th, 11th, and 15th, are much larger than the rest, the basal fourth and the basal third respectively being unarmed.

In the four posterior femora, the foliaceous lobe of the posterior or upper ventral crest is divided by a wide and deep rounded emargination into two bifid lobules, of which the distal is the larger; that of the upper dorsal crest, into three, of which the proximal is small and simple, the middle is rather larger and bifid, and the distal much larger and also bifid; and that of the lower or anterior dorsal crest, into two, of which the proximal is the larger and bilobed and the distal is the smaller and only obscurely sub-divided.

Male unknown.

Total length 112 millims.; height of head 5, breadth between tips of corneal spines 8·5, length of corneal spines 1·5; length of pronotum 44, of which the anterior and posterior lobes are respectively 56 and 384, breadth at supracoxal dilatation 4, near hinder end 4, at middle 2·5, height at middle 2·6; length of meso- and metanotum with seg. med. 16; of abdomen without seg. med., to end of 10th tergum 51, to end of cerci 54, breadth at middle of 4th segment 6, height of foliaceous lobe of 5th tergum 10·5, of 6th tergum 2·5; length of tegmina 43, breadth at middle 8·25, of marginal field 2·25; length of wings 41, breadth 21; length of fore coxa 15·5, femur 19, breadth at angulation 2·75, length of tibia from base to insertion of tarsus 15·25; of intermediate femur 13·5, tibia 14, 1st tarsal joint 4·5; of posterior femur 14, tibia 16·25, 1st tarsal joint 5·5; of antennæ (wanting); of cerci 5, breadth 3·6.

HAB.—Java.



# JOURNAL

OF THE

## ASIATIC SOCIETY OF BENGAL.



### Part II.—NATURAL SCIENCE.

No. IV.—1889.

#### XIX.—*On the Tortoises described as Chaibassia.*

By R. LYDEKKER, B. A., F. G. S.

[Received September 4th ;—Read Nov. 6th, 1889.]

(With two Wood-cuts.)

In endeavouring to determine the true affinities of the shell of a fossil tortoise in the British Museum, obtained many years ago from the Siwalik Hills, and which I have described and figured in the '*Palæontologia Indica* '\* as a form apparently allied to *Nicoria* (*Olemmys*) *trijuga*, a certain peculiarity in the relation of the hypoplastrals to the carapace suggested that it might prove to be identical with the imperfectly known existing form described as *Chaibassia tricarinata* (Blyth). Unfortunately, the British Museum possesses no recent example of that form, and I, therefore, wrote to my friend Mr. J. Wood-Mason, requesting the loan of a specimen by the aid of which it could be decided whether the fossil shell was or was not an allied type. In reply to this application, I received two specimens, one of which was the shell of a female collected by Prof. V. Ball in Sirguja, Chota Nagpūr, while the second was a male specimen, preserved in spirit, which was obtained from the Naga Hills in Assam, and was one of the types of *Chaibassia theobaldi*, Anderson.

A comparison of the two specimens with the Siwalik fossil at once showed that we had to do with a form so closely allied to *Chaibassia tricarinata* that it was in all probability specifically identical; and the question then arose whether there was any justification for the separation

\* Series x, vol. iii. p. 176, pl. xxi, fig. 4.

of the Assamese *O. theobaldi* from the typical Bengal form, and also whether there were good grounds for regarding *Chaibassia* as entitled to generic distinction. In attempting to decide these points, I had the advantage of consulting with my friend Mr. G. A. Boulenger, of the British Museum, to whom all students of the Chelonia are so much indebted for his recently published 'Catalogue'\* of that order; and, after careful comparison and examination, we both came to the conclusion that *Chaibassia theobaldi* was not separable from *O. tricarinata*, and also that the genus *Chaibassia* itself was not a valid one. Having arrived at these conclusions, it seemed advisable to put them on record, and, since the type of this so-called genus was first described in the 'Journal of the Asiatic Society of Bengal,' it appeared most appropriate to bring them to the notice of the same Society.

The tortoise on which the genus *Chaibassia* was subsequently founded was originally described by Blyth† under the name of *Geoemyda tricarinata* upon the evidence of a specimen obtained from Chaibassa, in Chota Nagpur, Lower Bengal. I have had no opportunity of examining the type specimen, even if that still exists, but, since the above-mentioned female shell from the neighbouring region of Sirguja in the same district agrees in all respects with the description of the type, it may be safely regarded as specifically the same.

In founding the genus *Chaibassia*, Mr. W. Theobald‡ appears to have taken his description from the two specimens already alluded to as having been obtained from the Naga Hills, which he regarded (and, as it now appears, rightly) as identical with the so-called *Geoemyda tricarinata*. These specimens showed that this tortoise differed from *Geoemyda* by the presence of a temporal or zygomatic arcade, and Mr. Theobald accordingly defined his new genus as "habit of *Geoemyda*, but zygomatic arch complete." In the course of his description it is, however, incidentally mentioned that *Chaibassia tricarinata* may be distinguished from *Nicoria* (*Melanocheilus*) *trijuga* by the brown instead of white colour of the iris; thereby implying a close similarity between the two forms. A difference in the claws of the two species is also noticed. Having thus incidentally mentioned the similarity of *O. tricarinata* and *N. trijuga*, it is very remarkable that Mr. Theobald should not have clearly stated what he regarded as the generic distinction between the two, and that the two forms were placed respectively in the so-called families *Testudinidae* and *Emydidæ*, which have no real distinctive features, and have therefore been united by Mr. Boulenger.

\* Catalogue of the Chelonians, Rhynchocephalians, and Crocodiles in the British Museum, London, (1889).

† J. A. S. B., vol. xxiv, p. 714 (1856). ‡ Cat. Rept. British India, p. 6 (1876).

Three years later Dr. J. Anderson\* gave a further description of *Chaibassia*, in which he described it as allied to *Geoemyda*, but with a bony temporal, or zygomatic arch, the feet not webbed, and the hypoplastrals usually attached to the carapace only by ligament.† The Assamese form was here described under the name of *O. theobaldi*, and was stated to differ from the type species by the contour of the first vertebral shield, the longer facial portion of the head, and certain slight details of coloration.

In his 'Catalogue of Chelonians,'‡ Mr. Boulenger introduced the genus *Chaibassia*, on the authority of Anderson, after *Geoemyda*, stating that its characters required further investigation, and omitting it from the number of well-authenticated genera. The characters of the two so-called species were likewise given, as culled from the description of Messrs. Theobald and Anderson.

On comparing the shell of the male specimen from the Naga Hills (of which a lateral view is given in Fig. 1, A) with that of the typical female shell from Chota Nagpur (Fig. 1, B. C.), it is at once apparent that the slight difference in the contour of the first vertebral shield, and also the slight variation in colour, are but individual peculiarities; and that still more marked variations occur in the large series of specimens of *Nicoria trijuga* preserved in the British Museum. There has, indeed, been no opportunity of comparing the heads of the Assam and Bengal forms, but I cannot regard the alleged longer muzzle of the former as anything more than an individual variation. There is, indeed, one very striking difference between the two shells, *viz.*, that, whereas in the Bengal specimen the hypoplastrals join the carapace merely by a ligamentous attachment, in the Assam specimen there is a perfect sutural union between the two. In the face, however, of the resemblance of the two specimens in all other respects, it appears, both to Mr. Boulenger and myself, that we have again to do with a variation which cannot be regarded as of more than individual importance, although, as will be shown below, it is one which appears to be of comparatively common occurrence. The result, then, of this comparison is to show that *Chaibassia theobaldi* is not specifically separable from the tortoise described as *O. tricarinata*.

With regard to the generic position of this form it will be evident from the preceding observations that the occasional ligamentous union of the hypoplastrals with the carapace can be of no importance from this

\* Zoological Results of Yunnan Expeditions, pp. 718-720 (1879).

† Some confusion in this description is pointed out by Boulenger 'Catalogue,' p. 139, note

‡ P. 139.



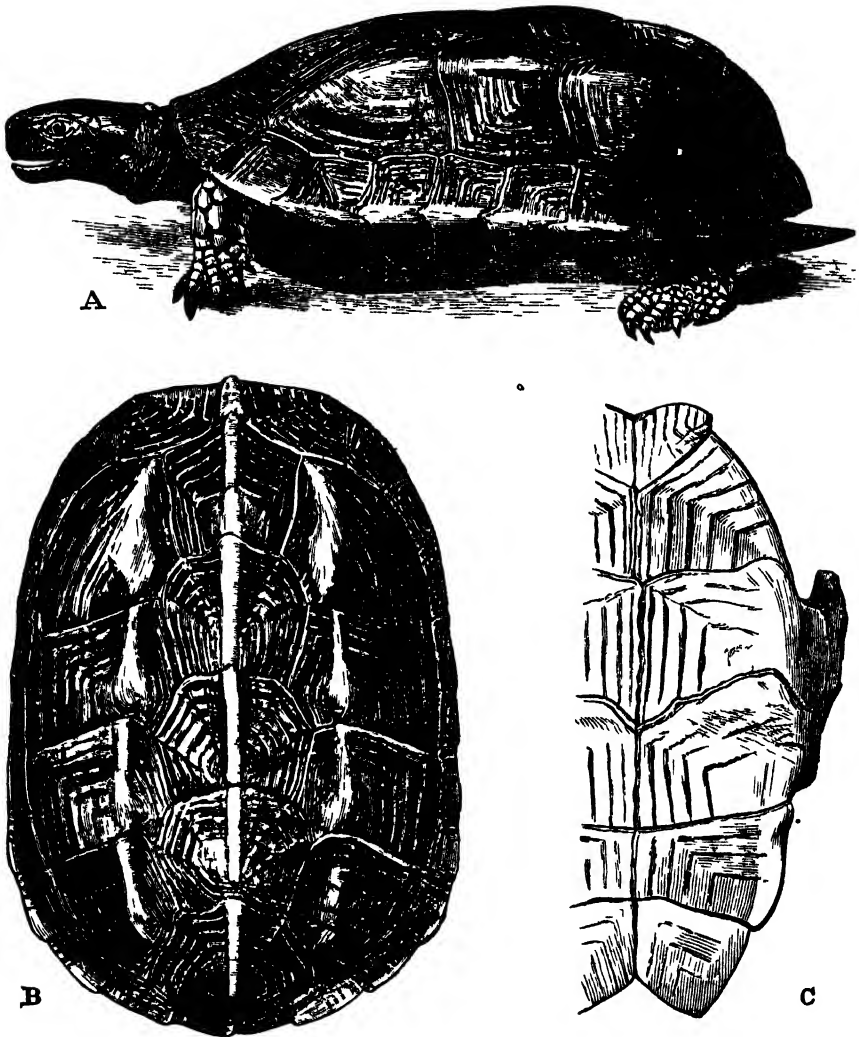


Fig. 1. *Nicoria tricarinata*,  $\frac{1}{2}$  nat. size. A. Lateral view of a male from the Naga Hills. B. Dorsal view of the carapace of a female from Chota Nagpur. C. Left half of the plastron of the same individual.

point of view. Further, on comparison with the representatives of the Oriental and Neotropical genus *Nicoria* (*Melanochelys*), it appears that the chelonian under consideration agrees in all respects with the definition of that genus given by Mr. Boulenger,\* which is as follows:

"Neural plates mostly hexagonal, short-sided behind, or alternately tetragonal or octagonal. Plastron extensively united to the carapace by suture, with short axillary and inguinal buttresses, just reaching the first and fifth costal plates respectively; entoplastron intersected by the humero-pectoral suture. Skull with a bony temporal arch; alveolar surface without a median ridge; choanæ between the eyes. Upper surface of head covered with undivided skin. Digits with a short web, or without. Tail short, not longer in the young than in the adult."

In the Sirguja specimen, with the exception of the one between the hyo- and hypoplastrals, the whole of the sutures between the bones of the shell are completely obliterated; but, on raising the second vertebral shield of the Assam specimen, it was seen that the underlying neural bones have the characteristic features of *Nicoria*; while, on the plastron, the intersection of the entoplastral bone by the sulcus dividing the humeral and pectoral shields is distinctly visible. The short axillary and inguinal buttresses are also displayed in the female shell; while the skull of the male exhibits the undivided skin on the upper surface, the presence of a temporal arcade, the absence of an oral ridge, and the position of the posterior nares (choanæ) on the transverse line of the orbits. The digits have an almost imperceptible web, and in this respect approximate to the South American *N. annulata*, in which the web is totally wanting. The shortness of the tail is well shown in the figure.

It appears, therefore, to be quite clear that the genus *Chaibassia* should be included in *Nicoria*, and that the one species of the former should be known as *Nicoria tricarinata*.

Mr. Boulenger† divides the six species of *Nicoria* recognised by him into two groups, the first of which is characterized by its tricarinate carapace, and includes the Oriental *N. spengleri* and *N. trijuga*, while the second has a unicarinate carapace, and is exclusively American. In *N. trijuga* and apparently in *N. spengleri* the digits are distinctly webbed, and the posterior portion of the carapace slopes gradually from the vertex to the margin. The almost total absence of webbing in the present species, and the abrupt descent of the posterior portion of the carapace, indicate terrestrial habits; and it thus appears that *N. tricarinata* is a representative of the Oriental tricarinate group of the genus occupying an analogous position to that held in the Neotropical unicari-

\* Catalogue, pp. 118, 119.

† Loc. cit.

nate group by *N. annulata*. In respect of coloration, *N. tricarinata* is strictly comparable with *N. trijuga*, and especially with the varieties *thermalis* and *edeniana*, in which the carapace is black, with more less distinctly yellow carinæ; but the uniformly yellow plastron is very distinctive of the present form, which may be defined as follows.

Carapace elongately oval, somewhat vaulted, with a sudden descent from the vertex to the posterior margin, and tricarinate. Vertebral shields as broad as, or broader than, long (with the exception in some cases of the first), and much narrower than the costals; nuchal long and narrow. Plastron moderately large; the width of the bridge considerably exceeding that of the posterior lobe, which is broadly notched; front lobe comparatively long and narrow; in some cases a ligamentous union between hypoplastrals and carapace. Pectoral and abdominal shields nearly equal in size; the longest longitudinal suture is between the pectorals, the shortest between the femorals; suture between the humerals as long as that between the anals, and a little shorter than that between the gulars; an axillary but no inguinal shield. Upper jaw not hooked, notched mesially; the width of the mandible at the symphysis is less than the diameter of the orbit. Digits without distinct web. Tail shorter than the head. Carapace dark brown or black, with the ridges deep yellow; plastron pale or orange-yellow. Head and neck brownish, with an orange stripe from the nostrils over the eyes, and a paler patch on either side near the mandible; iris brown.

Length of carapace usually about, 13 to 14·5 centimètres.\*

HAB. Bengal and Assam.

That the present form is almost exclusively terrestrial is shown by the practical absence of webbing in the digits, and the contour of the posterior portion of the carapace, which approximates to that obtaining in *Testudo*. The ligamentous union of the hypoplastrals with the carapace in certain individuals is an interesting feature as showing an approximation to *Cyclemys*, where the union between the plastron and carapace is entirely ligamentous, and there is also in the adult a transverse hinge between the two lobes of the plastron itself. The occasional occurrence of this partial ligamentous union in the present form affords a curious comment on the divisions of the *Testudinata* into sections according to the nature of the union between the carapace and the plastron which have been proposed by some writers. By all authors previous to Mr. Boulenger, *Emys*, *Cistudo*, and *Cyclemys* on the one hand and *Clemmys* and *Nicôria* on the other, had been approximated, or generically united, in the system, on the ground of the presence or absence of the plastral hinge.

\* Dr Anderson gives the length of the shell of the Assam form as 16 centimètres but in the male it is only 13 centimètres.

Having now sufficiently discussed the affinities of the recent form it remains to say a few words in regard to the fossil shell, of which a figure of the dorsal aspect is given in Fig. 2. The contour of the carapace is so essentially that of the recent form that there can be but little hesitation in referring the fossil specimen to the recent species. This conclusion is confirmed by the circumstance (which first led me to think that the fossil was allied to the so-called *Chaibassia*) that the hypoplastrals had a ligamentous union with the carapace, as is shown by the smooth surface on the inner side of the inguinal marginals. The fossil shell is, however, decidedly larger than that of the existing race, its length when entire having been about 17 centimètres. The first and second vertebral shields are also relatively wider than in either of the existing examples; while all the vertebrals tend to assume a more decided balloon-shape in the fossil, which it may therefore be convenient to regard as a distinct race under the name of *Nicoria tricarinata*, var. *sivalensis*. The fossil specimen agrees with the recent Sirguja example in the total obliteration of all the sutures between the component bones of the carapace.

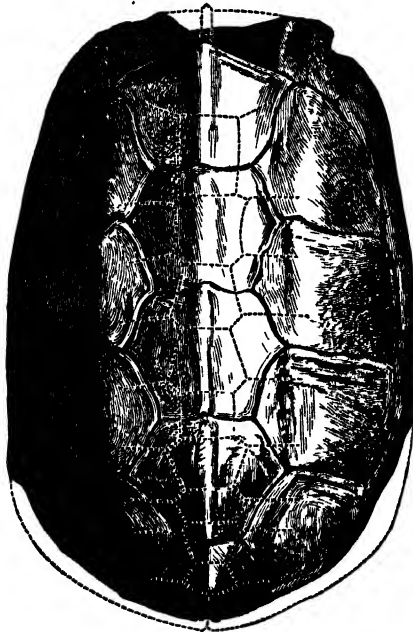


Fig. 2. Carapace of *Nicoria tricarinata*, var. *sivalensis*, from the Pliocene of the Siwalik Hills,  $\frac{1}{4}$  nat. size. The neural bones are restored in outline from *N. trijuga*.

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**XX.**—*Étude sur les Arachnides de l' Himalaya recueillis par MM. OLDHAM et WOOD-MASON et faisant partie des collections de l' Indian Museum. 1re Partie. Par E. SIMON. Communicated by THE SUPER-INTENDENT OF THE INDIAN MUSEUM.*

[Received Oct. 9th;—Read Nov. 6th, 1889.]

1. *ÆLURILLUS QUADRIMACULATUS*, sp. nov.

♀. Long. 5.7 mm.

Cephalothorax sat elongatus, postice ampliatus, niger, pilis fulvo-cinereis, marginem versus sensim albidioribus, crebre vestitus. Pili oculorum supra fulvi infra oculos albidi. Pili clypei densi, longi, et albidi. Oculi antici viridi-metallici, in linea modice recurva. Oculorum series postica cephalothorace non multo angustior. Abdomen oblongum, antice obtusè truncatum, fulvo-cinereo dense pubescens, maculis elongatis quatuor biseriatis nigris notatum, subtus omnino albedo-pubescens. Sternum fuscum, nitidum, parce albo-pilosum. Pedes-maxillares luridi, anguste fusco-annulati. Pedes fulvi, confuse fusco-annulati, albo-cinereo-hirsuti, numerose aculeati. Tarsi quatuor antici metatarsis breviores. Patella cum tibia parium 3ti et 4ti circiter æquilonga, sed articuli 3i paris robustiores. (Vulva haud plane adulta).

Jaonsar, Siri, 5000 pieds, (*Oldham*).

Species abdomine quadrimaculato, cephalothorace elongato fere ut in genere *Phlegra*, tarsis anticis metatarsis brevioribus eximie distincta.

2. *PHLEGRA ICIOIDES*, sp. nov.

♀. Long. 5 mm.

Cephalothorax elongatus, humilis, parte cephalica nigra, parte thoracica fusco-ravida, vitta media angusta vittaque marginali latiore luridis notata, supra pallide flavido marginem versus albedo-pubescens. Pili oculorum et clypei creberrimi et albidi. Oculi antici valde inæquales, in linea plane recta. Oculi seriei 2æ paulo ante medium, inter laterales anticos et posticos siti. Oculorum series tertia cephalothorace vix angustior. Abdomen longe oblongum, pallide testaceum omnino albedo-pubescens, utrinque crebre fusco-punctatum et reticulatum, in parte prima vitta longitudinali lineam mediam fuscam includente, in parte secunda arcibus transversis acutis 3-4 testaceis fuscisque notatum, subtus omnino testaceum. Sternum obscure fuscum. Chelæ, oris partes, pedes-maxillares, pedesque omnino flavo-lurida, tibiis anticis inferne 2-3, metatarsis 2-2 breviter aculeatis, tibiis metatarsisque posticis parce aculeatis, metatarsis aculeo exteriori parvo, aculeis interioribus parvis binis atque aculeis apicalibus ordinariis tantum instructis, patellis

cunctis muticis. Vulvæ area fulva, simplex, plana, postice margine transverso in medio leviter angulato, limitata.

Jaonsar, Siri, 5000 pieds, (*Oldham*).

Species valde insignis, cephalothorace humili, pedibus posticis parce aculeatis, patellis muticis etc. fere ut in genere *Icio*. *P. semiglabrata*, E. Sim., ex Hispania, sat affinis.

### 3. HOMALATTUS MUS, sp. nov.

♀. Long. 5 mm.

Cephalothorax niger, coriaceus, crebre et longe albido-cinereo-pilosus, circiter æque longus ac latus, utrinque ample rotundus, supra fere planus. Pili oculorum fulvi. Pili clypei nivei, creberrimi et longissimi, chelis fere omnino obtectis. Oculi antici in linea subrecta, inter se sat late remoti. Abdomen late oblongum, depressum, nigrum, supra albido-cinereo, utrinque fulvo-pubescent, in lateribus lineis obliquis abbreviatis albis 1-4 sectum. Pedes antici robustissimi, femore late clavato, nigri tarso rufescenti, pedes reliqui obscure fusci, metatarsis tarsisque dilutioribus sed fusco-annulatis, cuncti cinereo albidoque hirsuti. Tibiæ anticæ robustissimæ, aculeis binis interioribus subapicalibus tantum armatæ, metatarsi brevissimi (tarsis breviores) aculeis robustis binis muniti. Pedes-maxillares parvi et graciles, rufescentes, tarso infuscato leviter depresso. Plaga vulvæ simplex, plagula media obtuse triquetra, medio depressa et antice aperta notata.

Jaonsar, Siri, 5000 pieds, (*Oldham*).

### 4. PLEXIPPUS PAYKULLI, Aud. in Sav., Eg. Ar. 1827, Pl. VII, F. 22.

Jaonsar, Thadyar, 2500 pieds; Siri, 5000 pieds, (*Oldham*).

5. *PENCETIA VIRIDANA*, Stoliczka, J. A. S. B. XXXVIII, 1889, p. 220, Pl. XX, F. 1 (*Sphasus*).—*Pencetia viridana*, E. Sim., Ann. Gen. xx, 1884, p. 326. ? *Pencetia prasina*, Thorell, Ann. Gen. 1887, p. 325.

Jaonsar, Thadyar, 2500 pieds, (*Oldham*).

### 6. SELENOPS MONTIGENA, sp. nov.

♀. Long. 11 mm.

*S. malabarensi*, E. Sim., valde affinis et subsimilis, differt oculis mediis anticis lateralibus evidentius minoribus, metatarsis anticis inferne 3-3 aculeatis (in *S. malabarensi* 2-2 tantum aculeatis), vulvæ area plana, nigra, subrotunda, antice stria arcuata limitata et plagulam anguste longitudinalem ovatam includente (in *S. malabarensi* plaga anteriore subrotunda vel cordiformi fulva et margine postico crasso

fusco postice inciso notata).—Cephalothorax læte fusco-castaneus, regione frontali obscuriore, pallide lurido-pubescens. Abdomen ovatum, depressum, antice truncatum, fusco-testaceum crebre pallide lurido-pubescens. Sternum pedesque fulvo-rufescentia.

Jaonsar, Kumia, 6000 pieds, (*Oldham*).

#### 7. GASTERACANTHA UNGUIFERA, sp. nov.

♀. Long. tot. 5 mm. Long. scuti 3.5 mm.; lat. scuti 5.5 mm.

Cephalothorax obscure fusco-rufescens, nitidus sed parum dense transversim rugatus, crasse albido-pilosus, parte cephalica alta, apice profunde sulcata. Oculi medii subæquales, aream trapeziformem latiore quam longiorem et antice quam postice multo angustiore occupantes. Clypeus oculis mediis anticis non multo latior. Scutum abdominale fere  $\frac{1}{3}$  latius quam longius, transversim ovatum et leviter excavatum, aculeis sex armatum, aculeis lateralibus his parvis conicis et acutis, lateralibus 2is sat brevibus sed crassissimis, apice abrupte angustioribus acutis et leviter uncatis, aculeis posticis lateralibus non multo minoribus, ad basin crassis, ad apicem valde attonuatis atque acutis; scutum supra sat regulariter granosum sed in medio sensim lævius, punctis ocelliformibus ordinariis impressum, obscuro flavum aculeis ravidis, vel olivaceum et zonis transversis dilutioribus confusis notatum, vel antice linea longitudinali et macula media obtuse triquetra læte flavis decoratum. Venter sat crebre granosus, ater utrinque leviter fulvo-notatus, tuberculo medio maximo munitus. Sternum valde granosum, atrum, antice macula dilutiore parum expressa notatum. Pedes breves et robusti, obscure ferruginei, metatarsis tarsisque dilutioribus, articulis cunctis apice latissimo fusco-annulatis.

♂. Long. 3 mm.

Cephalothorax fere ut in femina sed fronte medio paulo prominentiore et clypeo retro-obliquo. Scutum abdominale fere ut in femina sed magis quadratum, supra atrum, ad marginem leviter fulvo-variaturum, aculeis sex brevioribus et cunctis conicis subsimilibus instructum. Venter plica transversa elevata munitus sed tuberculo carens. Pedes paulo longiores, tibiis anticis ad basin leviter depressis, tibia li parvis intus, prope basin, aculeis binis brevibus sed validis et dentiformibus atque ad apicem aculeo simili instructa. Pedes-maxillares breves et robusti, atri, tarso supra ferrugineo.

Jaonsar, Thadyar, 2600 pieds, (*Oldham*).

Species valde insignis, aculeis lateralibus 2is fere ut in *Stanneoclavi* mucronatis eximie distincta, sectionem novam in genere *Gasteracantha* (sensu stricto) formans.

## 8. GLYPTOGONA EXCELSA, sp. nov.

♀. Long. 4.5 mm.

Cephalothorax brevis, obscure fulvo-rufescens, marginem versus infuscatus, parte thoracica valde declivi et glabra, parte cephalica antice attenuata levissime acclivi et crasse albo-setosa. Oculi medii æquales, aream subquadrata et subverticalem occupantes. Oculi quatuor antici (antice visi) lineam leviter procurvam formantes. Clypeus altus sed area oculorum mediorum paulo angustior. Abdomen breve, subrotundum sed postice in tuberculum crassum et obtusum elevatum, supra albidum, postice nigricanti marginatum. Venter nigricans, maculis binis elongatis et utrinque prope mammillas puncto parvo albidis notatus. Sternum, chelæ, et partes oris nigræ. Pedes breves et robusti, luridi, femoribus quatuor anticis, basi excepto, infuscatis, articulis reliquis ferrugineis, pedes quatuor postici femoribus, tibiis, metatarsisque ad apicem fusco-annulatis, tarsis fuscis, patellis tibiisque anticis supra deplanatis, aculeis paucis albis instructis. Vulvæ uncus crassus et brevis, ovatus apice attenuatus et obtusus, scapum ungue obtectum, subquadratum, nigrum, parte media rufula sulcata munitum.

Jaonsar, Dartar, 4500 pieds, (*Oldham*).

A *G. sextuberculata*, Keyserl., valde differt imprimis abdomine supra unituberculato, oculis mediis inter se æquis, clypeo area oculorum mediorum paulo angustiore etc.\*

## 9. CYCLOSA SPERIFERA, sp. nov.

♀. Long. 6.7 mm.

Cephalothorax angustus et longus, luridus, tenuiter fusco-punctatus, parte cephalica postice macula dilutiore V-formante notata et vittis obliquis fuscis discreta, parte thoracica ad marginem infuscata. Oculi medii postici subcontigui, antici posticis plus duplo majores. Clypeus angustissimus. Abdomen longe oblongum, antice acuminatum et in tuberculum obtusum subverticale elevatum, postice in tuberculum longius, utrinque ad basin obtuse mucronatum, productum, supra albo-flavidum, in lateribus fulvum, fusco-reticulatum et oblique albo-segmentatum. Venter crebre albido-punctatus. Sternum pallide fuscum, inæquale, antice vitta transversa, utrinque maculis binis magnis et macula apicali minore albidis notatum. Partes oris chelæque fusco-rufescentes. Pedes-maxillares pedesque luridi, femoribus, praesertim anticis, annulo submedio fusco et supra et infra interrupto, tibiis metatarsisque annulo medio annuloque apicali angustissimis et parum expressis (annulo apicali tibiæ 4i paris excepto) notatis, metatarsis cunctis et pedibus sex posticis muticis, femoribus tibiisque anticis aculeis paucis brevibus

\* cf. E. Simon, Ann. Soc. Ent. Fr. 1884, p. 327.



et debilibus armatis. Vulvæ uncus rufulus, transversim plicatus, haud longior quam lator, late cordiformis, apice breviter et abrupte angustior atque inflexus, scapum crassum convexum et transversum, fusconitidum, utrinque rotundum, incisura media parva et acute triquetra notatum.

♂. Long. 5 mm.

Cephalothorax fusco-castaneus, in medio longitudinaliter dilutior, parte thoracica latiore et ovata. Abdomen minus et brevius, antice obtusum haud elevatum, postice breviter et obtusissimè productum. Pedes pallide luridi, latius et distinctius fusco-rufescenti annulati, metatarsis parce aculeatis, tibia 2i parvis tibia 1i parvis paulo crassiore, levissime curvata et intus aculeis nigris, robustis et biseriatis (3-4) armata. Pedes-maxillares breves et robusti, fusci, bulbo rufulo disciformi, lamina apicali maxima fusca apice valde spiraliter contorta, carinata atque acuta, insigniter manito.

Jaonsar, Thadyar, 3500 pieds, (*Oldham*).

#### 10. CYCLOSA FISSICAUDA, sp. nov.

♀ (pullus). Long. 3 mm.

Cephalothorax obscure fuscus subniger, regione oculari leviter dilutior, parte cephalica convexa, sulco semicirculari profundo discreta, parte thoracica fovea media parva sed profunda et rotunda impressa. Abdomen breviter ovatum, antice rotundum, paulo ante medium tuberculis binis obtusissimis, ad apicem tuberculo majore crasso, apice obtuse bifido, munitum, supra testaceum, crebre fusco-variatus, subtus atrum, maculis albis binis transversim elongatis vittam fere formantibus et utrinque, secundum mammillas, punctis albis parvis binis ornatum. Sternum fuscum, antice vitta transversa, utrinque maculis binis maculaque apicali albidis subconfluentibus ornatum. Pedes robusti et breves, submutici, femoribus ad apicem fusco-annulatis, patellis tibiis metatarsisque sex anterioribus ad apicem et in medio angustissime fusco-cinctis, posticis apice distinctius annulatis, tarsis cunctis apice fuscis.

Jaonsar, Dartar, 4500 pieds, (*Oldham*).

*Cyclosa oculata*, Walck., affinis sed certe distincta.

#### 11. EPHEIRA CAMILLA, sp. nov.

♀. Long. 6.5 mm.

*Ep. dromadaria*, Walck., valde affinis et subsimilis, differt area oculorum mediorum antice quam postice evidentius latiore et oculis mediis anticis evidentius majoribus, vulvæ carinis scapi parallelis (in *E. dromadaria* antice convergentibus). Cætera ut in *E. dromadaria*.

Jaonsar, Deota, 7700 pieds, (*Oldham*).

12. *EPEIRA LAGLAIZEI*, E. Simon, Ann. Soc. ent. Fr. 1877, p. 77.—*Epeira thelura*, Thorell, Rag. Mal. etc., ii, 1878, p. 84. *Epeira laglaizei*, Thorell, l. c., iii, 1881, p. 119.

Jaonsar, Thadyar, 2500 pieds, (*Oldham*).

13. *EPEIRA HIMALAYANA*, sp. nov.

♀. Long. 7·5 mm.

Cephalothorax pallide luridus, lævis, parce albo-pilosus. Area oculorum mediorum vix longior quam latior et antice quam postice latior, oculi medii antici posticis paulo minores. Oculi laterales a mediis sat late remoti, inter se anguste separati, anticus postico paulo major. Clypeus oculis mediis anticis non multo latior. Abdomen breviter ovatum, antice leviter acuminatum, supra albo-opacum, in medio punctis impressis minutis quatuor et utrinque punctis nigris parvis elongatis (lineiformibus) quatuor uniseriatis ornatum, subtus fulvo-testaceum et maculis albidis confusis quatuor, quadratum formantibus, notatum. Sternum, chelæ, pedesque lurido-rufescentia. Pedes breves et robusti, aculeis ordinariis numerosis fulvis et pellucentibus armati. Vulvæ uncus sat brevis et crassus, non multo longior quam latior, apice attenuatus sed obtusus et marginatus, fulvus et superne transversim rugatus.

Jaonsar, Deota, 7700 pieds; Bujkoti, 9000 pieds; Kumia, 6000 pieds, (*Oldham*).

*E. alpicæ*, L. Kock, valde affinis et subsimilis, differt area oculorum mediorum paulo brevior, oculis lateralibus utrinque disjunctis, abdomine antice magis acuminato et punctis elongatis nigris quatuor utrinque ornato, aculeis pedum fulvis etc.

*E. prædata*, Cambr., ex Yarkand, certe affinis est *E. himalayana* sed verisimiliter distincta.

14. *EPEIRA NYMPHA*, sp. nov.

♀. Long. 6 mm.

Cephalothorax obscure fulvus, crasse albido-pilosus, parte cephalica paulo dilutior et postice macula albida V-formante notata. Oculi medii subæquales, aream circiter æque latam et longam, et antice quam postice non multo latior, occupantes. Oculi laterales a mediis non late remoti, æqui, et inter se angustissime separati. Clypeus oculis mediis anticis hand latior. Abdomen circiter æque longum ac latum, antice late rotundum, postice breviter attenuatum atque obtusum, fulvum, crebre testaceo-punctatum, utrinque vitta albidior sinuosa sæpe intus anguste fusco-marginata notatum, subtus fulvum, vitta media lata

paulo obscuriore, anguste et parum distincte testaceo-marginata, notatum. Sternum castaneum. Chelæ obscure fulvæ apice dilutiores. Pedes sat longi et graciles, fulvi, femoribus ad apicem tibiis metatarsisque ad basin atque ad apicem, tarsisque ad apicem pallide fusco-annulatis, aculeis paucis, gracillimis fuscis, metatarsis, præsertim anticis, submuticis. Vulvæ uncus sat brevis et latus, subparallelus, apice obtusus et marginatus supra fulvus planus et transversim rugatus, scapum transversum, utrinque, secundum basin unci, subquadratum.

Jaonsar, Deota, 7700 piëds, (*Oldham*).

*E. triguttatæ*, Fabr., ex Europa, sat affinis.

#### 15. *EPEIRA MINUTALIS*, sp. nov.

♀. Long. 5 mm.

Cephalothorax obscure luridus, antice paulo dilutior, parce et crasse albido-setosus, parum convexus et antice sat attenuatus, oculi nigro-cincti. Oculi medii aream paulo longiorem quam latiore et antice quam postice vix angustiore occupantes, antici posticis paulo minores, laterales subæquales et subcontigui, a mediis non late remoti. Abdomen sat longe ovatum, antice attenuatum et tuberculis humeralibus obtusis munitum, postice leviter attenuatum atque obtusum, supra fulvo-olivaceum et in parte secunda vittis fuscis binis flexuosis, figuram foliiformem designantibus, ornatum, interdum latius nigricanti-marginatum. Venter vitta media lata et parallela nigra et postice, secundum mammillas, utrinque puncto albido notatus. Sternum nigrum. Chelæ castaneæ. Pedes sat longi, luridi, femoribus ad apicem, tibiis metatarsisque in medio atque ad apicem fusco-rufescenti-annulatis, tarsis apice infuscatiss, aculeis ordinariis nigris, parum longis. Vulvæ uncus fulvus, sat brevis, triquetrus, apice attenuatus et subacutus, scapo oblecto.

Jaonsar, Deota, 7700 piëds, (*Oldham*).

Species valde insignis inter *E. dioidiam* et *dromadariam*, Walck.

#### 16. *LARINIA QUADRINOTATA*, sp. nov.

♀ (pullus). Long. 8 mm.

Cephalothorax angustus et longus, pallide luridus, crasse et longe albo-hirsutus, linea media fusca oculos haud attingente sed antice in maculam parvam ampliata, notatus. Area oculorum mediorum paulo longior quam latior, medii postici inter se juxte contigui, antici posticis paulo majores. Oculi quatuor antici, antice visi, lineam leviter recurvam formantes, medii a lateralibus quam inter se remotiores. Abdomen angustissimum, longum et parallelum, apice in caudam obtusam breviter productum, albido-cinereum, parce albido-setosum, linea media

integra albidior et punctis nigris quatuor notatum, subtus longitudinaliter infuscatum, mammillis fuscis nigricanti-limbatis. Sternum, chelæ, partes oris pedesque omnino lurida, aculeis pedum sat numerosis tenuibus, cunctis albidis et pellucetibus. (Vulva haud adulta).

Jaonsar, Deikhera, 4000 pieds; Thadyar, 2500 pieds, (*Oldham*).

*L. chlorei*, Sav., ex *Ægypto* et *L. pubiventri*, E. Sim., ex Asia centrali, affinis, imprimis differt ventre infuscato.

• 17. *CERCIDIA PUNCTIGERA*, sp. nov.

♀. Long. 4.5 mm.

Cephalothorax niger, parte cephalica dilutior et rufescente parco rugosa, longe et crasse albido-setosa, lata vix attenuata et valde convexa. Oculi medii æqui, aream subquadratum occupantes. Clypeus oculis mediis anticis circiter duplo latior. Abdomen late oblongum, ad marginem anticum obtuse prominens, utrinque levissime sinuosum, ad apicem obtuse et breviter trimucronatum, mucrone medio lateralibus paulo majore et bilobato, supra subplanum, duriusculum, sat crebre et subtiliter impressum, albido-flavidum, fusco-atomarium, tuberculis albidioribus et nigro-cinctis. Venter niger, crebre testaceo punctatus. Sternum chelæque nigra. Pedes breves, robusti et fere mutici, obscure luridi, femoribus ad apicem, tibiis metatarsisque ad basin atque ad apicem late fusco-annulatis, annulis tibiæ anticarum sæpe confluentibus. Vulvæ uncus parvus, angustus et rectus, scapum magnum, tripartitum, parte anteriore (sub ungue) fulva ovato-transversa, partibus posticis crassis, fuscis obliquis marginem formantibus.

♂. Long. 3.5 mm.

Cephalothorax antice magis attenuatus, lævis, nitidus, fusco-rufescens, parte cephalica postice dilutior et testacea. Abdomen fere parallelum, antice posticeque obtusum, haud mucronatum, duriusculum et impresso-punctatum, supra fusco-olivaceum, vitta media albida, in medio anguloso-dentata, et lineam mediam fulvam includente, notatum. Venter niger, utrinque testaceo-marginatus. Pedes luridi, confuse fusco-rufescenti annulati, quatuor antici reliquis robustiores et evidenter longiores, tibiis haud incrassatis, sat numerose aculeatis, metatarsis muticis. Pedes-maxillares breves et robusti, tarso insigni, superne ad basin in tuberculo magno erecto, obtuso et compresso producto.

Jaonsar, Deota, 7700 pieds; Bujkoti, 9000 pieds, (*Oldham*).

18. ? *ARGYROPEIRA ANGUSTATA*, Stoliczka, J. A. S. B., XXXVIII, 1889, p. 241, Pl. XX, F. 7, (sub *Nephila*).

De nombreux individus mais tous très jeunes, ce qui laisse des

doutes sur leur détermination.—Pent-être faudrait-il les rapporter à *Mesomista* Cambridge du Yarkand.

Jaonsar, Deota, 7700 pieds; Dartar, 2500 pieds; Lokhar, 6000 pieds, (*Oldham*).

19. *NEPHILA MACULATA*, Fabr., Ent. Syst., II, 1793, p. 425, (*Aranea*).

Dehra Dun, 2300 pieds, (*Wood-Mason*).

20. *MIAGRAMMOPES EXTENSA*, sp. nov.

♀. Long. 10.5 mm.

Cephalothorax luridus, pilis pronis plumosis albidis sat dense vestitus, multo longior quam lator, antice posticeque fere recte sectus, postice sensim attenuatus, supra fere planus sed utrinque, pone oculos, impressione arcuata notatus. Oculi longe ante medium siti, parvi, subæqui (medii lateralibus vix minores), lineam recurvam formantes, medii inter se quam a lateralibus multo remotiores. Abdomen pallide-luridum, albidopubescens, supra linea media obscuriore ramosa notatum, longissimum et subparallelum, antice recte sectum. Partes oris pedesque luridi, pedes antici et postici ad extremitates paulo obscuriores et rufescentes, femoribus anticis parvis et minute fusco-punctatis. Pedes antici reliquis multo longiores et robustiores, femoribus validis cylindræis, tibiis metatarsisque leviter compressis, metatarsis 4i parvis tibiis plus duplo brevioribus, paulo crassioribus et compressis, inferne rugosis, superne, in parte basali, leviter excavatis et calamistro, dimidium articulum saltem occupante, munitis.

♂ (pullus). Femina subsimilis sed metatarso 4i parvis inferne setis claviformibus validis regulariter uniseriatis instructo superne calamistro munito. Pedes-maxillares (haud adulti) breves, inflati et pellicentes.

Jaonsar, Thadyar, 3500 pieds, (*Oldham*).

21. *THERIDION SUBVITTATUM*, sp. nov.

♀. Long. 3 mm.

Cephalothorax brevis, lævis, nitidus, fusco-luteus, marginem versus leviter dilutior, parvis albidopilosis. Oculi antici æqui, sat late et æque distantes, in linea sat procurva. Oculi postici in linea plane recta, medii paulo majores et a lateralibus quam inter se remotiores. Area mediorum circiter æque longa ac lata et antice quam postice lator, medii antici posticis minores. Clypeus verticalis, area oculorum lator. Abdomen magnum, globosum sed antice obtusissime et levissime emarginatum, albidopæcum, antice macula media, utrinque vitta marginali, postice ampliata, nigricantibus notatum, subtus fusco-testaceum et prope

phorum apiculatum panem binis parvis albis notatum. Sternum fusco-rufescens, laeve, nitidum, longius quam latius, postice longe attenuatum, eorum postica spatia articulo paulo angustiore a sese distantes. Partes oris subnigrae. Chelae clypeo longiores. Pedes modici, antici reliquis longiores et paulo robustiores, luvidi, femore tibiaque anticis ad apice late rufulo fulvove annulatis. Vulva simplex.

Jaonsar, Siri, 5000 pieds, (Oldham).

*T. vittato*, Walck., sat affine sed differt pictura et forma abdominis et proportionem oculorum. *T. incerto*, Gamb. (ex Yarkand), affine sed cephalothorace laevi et abdomine nigro-marginato certe differt.

## 22. CEDICUS BUCCULENTUS, sp. nov.

♀. Long. 13 mm.

Cephalothorax nigro-piceus in medio leviter rufescenti-tinctus sublævis, parte cephalica vix attenuata et valde convexa. Oculi postici in linea subrecta, parvi (laterales mediis paulo majores), medii a lateribus quam inter se paulo remotiores sed spatia diametro oculi fere duplo majore inter se sejuncti. Oculi antici in linea leviter procurva, medii minutissimi ad sese appropinquati, laterales mediis duplo majores et late ovati. Oculi laterales prominuli. Abdomen oblongum, atrum, fulvo-pubesceens, prope medium maculis parvis binis testaceis subgeminatis, in parte apicali arcibus transversis valde angulosis 4-5 testaceis decoratum. Venter obscure fulvo-testaceus. Sternum fulvo-rufescens nitidum. Chelae nigrae, validissimae, ad basin valde geniculae et prominentes, praesertim in parte apicali, rugosae, margine inferiore sulci dentibus quinque, ultimis duobus reliquis majoribus, margine superiore dentibus quatuor, ultimo majore. Pedes robusti et breves, fusco-rufescentes, femoribus, praesertim inferne, dilutioribus, aculeis longis ordinariis, tarsis posticis utrinque aculeis paucis munitis. Vulvae plaga fusca, plana, subrotunda, postice fovea sat minuta testacea in parte secunda plagulam parvam rufulam subquadrata inلودente notata.

Jaonsar, Kumia, 6000 pieds, (Oldham).

*C. marenti*, E. Sim., ex Asia centrali, affinis, praesertim differt armatura chelarum, pictura abdominis, et structura genitali.

## 23. CLUBIONA HYSGINA, sp. nov.

♀. Long. 7.5 mm.

Cephalothorax fulgo-rufescens, antice leviter sensim infuscatus, hanc nigro-marginatus, pilis pallide luteo-sericeis vestitus, stria brevi sed profunda. Oculi postici aequi a sese late et fere aequae distantes. Oculi antici aequidistantes et spatiis diametro oculi angustioribus a sese se-

juncti, medii majores rotundi, laterales ovati atque obliqui. Abdomen late oblongum, supra fusco-violaceum, pallide luteo-sericeo-pubescent, subtus paulo dilutius. Mammillæ, sternum, pedesque fulvo-rufescentia. Tibia cum patella 4i paris cephalothorace circiter æquilonga. Chelæ fusco-rufulæ nitidæ haud rugatæ, robustæ, sed non geniculatæ. Pedes aculeis ordinariis, tibia 3i paris inferne aculeis binis uniseriatis, basilari altera multo minore. Vulvæ area magna, fulva, convexa, postice leviter prominens et obtuse secta, antice fovea longitudinali parva sed profunda impressa.

Jaonsar, Deota, 7700 pieds, (*Oldham*).

*O. germanicæ*, Thorell, ex Europa, affinis, imprimis differt structura vulvæ.

#### 24. ANYPIÆNA SORICINA, sp. nov.

♀. Long. 7.4 mm.

Cephalothorax obscure fulvo-rufescens, pilis longis cinereo-albidis fulvisque dense vestitus, regione oculorum infuscata et parte cephalica linea media exillima nigricanti-notata. Oculi postici in linea evidenter procurva, medii inter se quam a lateralibus remotiores. Oculi antiqui inter se parum disjuncti in linea levissime procurva (subsecta), medii lateralibus minores. Area mediorum trapeziformis, multo longior quam latior. Clypeus oculis anticis vix angustior. Abdomen late ovatum convexum, cinereo-lividum, supra parce et inordinate fulvo-violaceo punctatum. Plica ventralis fere in medio sita. Mammillæ fulvæ. Sternum lurido-testaceum. Partes oris chelæque fusco-rufescentes. Chelæ læves, margine inferiore sulci serie dentium parvorum 4-5 munito. Pedes modice longi (4, 1, 2, 3), fulvo-olivacei vel rufescentes, fusco-variati, subannulati et sublineati, metatarsis tarsisque infuscatis, aculeis ordinariis numerosis et longis. Vulvæ plaga sat parva, nigra postice leviter attenuata et truncata, antice fovea parva, ovato-longitudinali profunda impressa.

Jaonsar, Deota, 7700 pieds, (*Oldham*).

*A. accentuata*, Walck., affinis, differt imprimis linea oculorum antica levissime procurva (in *A. accentuata* recta), area vulvæ minore, pedibus posterioribus anterioribus paulo longioribus, etc.

XXI.—*Notes on Indian Rotifers.\*—By H. H. ANDERSON, B. A.*

[Received Sept. 10th;—Read December 4th, 1889.]

(With Plates XIX—XXI.)

For the last few months I have devoted what little time I could spare for work with the microscope to the study of Rotifers with the twofold view of seeing what species already known to science I could find in our Calcutta tanks and of discovering new forms. I commenced on water and weed brought from the tanks on the further side of No. 2 Bridge, Entally, and I have found these so rich in specimens that I have not yet turned elsewhere for my materials. I propose to give in this paper a list of the known species that I have been able to determine, with notes as to frequency, of occurrence, date on which observed, and other details which may be of use to future observers. I have also described some that I believe to be new forms, but I have confined myself to those which are species of some known genus. I have drawings and descriptions of others in my notebooks for which new genera will, I think, have to be framed, but these I have reserved for further investigation. I have followed throughout Hudson's and Gosse's classification and nomenclature, and have based this paper on their book. As, however, their work includes descriptions of British Rotifers mainly, and only the most important of non-British species, there is some uncertainty whether some of the forms which I have imagined to be new may not be already known. I have studied Ehrenberg and Pritchard for continental forms, as well as such papers in scientific journals as I have been able to get access to, so I trust I have not here described as discoveries what have already been discovered. This paper is, I hope, only a first instalment, for our weedy tanks teem with Rotifera, and I have no doubt that a few months more work would enable me to give a second list as long as this one.

## Order 1. RHIZOTA.

## Family I. Flosculariadae.

## 1. FLOSCULARIA ORNATA, Ehrenberg.

Common, in many tanks, at all seasons, size  $\frac{1}{8}$ "', often much less.

\* Communicated by the Microscopical Society of Calcutta, before which it was read on Sept. 9th, 1889.



2. *FLOSCULARIA CAMPANULATA*, Dobie.

Only seen once or twice, size  $\frac{1}{10}$ ".

3. *FLOSCULARIA AMBIGUA*, Hudson.

Fairly common, on *Utricularia*, during the rains, size  $\frac{1}{10}$ ".

4. *FLOSCULARIA TENULOBATA*, n. sp., Pl. XIX.

Lobes five, linear, knobbed, composing almost the whole of the corona, the undivided portion being almost nothing. Knobs hemispherical with the flat surface inclined at an angle with the inner surface of the lobe. Setæ long, radiating from the knobs, smaller ones on the whole length of the lobe and on the smaller edge of the corona between their bases. The long linear lobes with their peculiarly shaped heads, and the very small undivided portion of the corona, are distinctive. The lobes seem capable of independent motion and have the appearance in certain positions of being jointed on to the neck. The neck is much narrower than the body, which again tapers gradually to its long and narrow foot, so that the creature has a somewhat spindle-shaped appearance. The internal structure corresponds with that of other *Floscules*, except that it seemed to me that the buccal orifice from the vestibule into the crop was situated at the side rather than at the centre of the crop, and that the tube leading from the one to the other hung against the wall of the crop. I note that, in the figure originally drawn by me, there is a projection at the base of the corona which looks like an antenna. I have not been able to verify this by subsequent observation. This species is a fine handsome creature from  $\frac{1}{10}$ " to  $\frac{1}{8}$ " in length. It is not at all shy, and I found it in great profusion last year (1888) during the rains on leaves of a species of *Utricularia*. I first saw it in 1887, and described it at a meeting of the Microscopical Society in the autumn of that year.

Family II. *Meliceradæ*.5. *MELICERTA RINGENS*, Schrank.

I have only come across a few specimens in Entally tanks: these, I saw in November, 1888. Mr. W. J. Simmons, however, tells me that he has found this species in great profusion in water taken from tanks in the Botanical Gardens.

I came across one specimen of a *Melicerta* with a tube very fluffy and irregular in shape differing greatly from the regular compact tube of *M. ringens*. The pellets, oval in shape, were not faecal, as I observed

them in process of formation in the cup beneath the chin. I was unable to discover any essential difference of structure.

#### 6. LIMNIAS CERATOPHYLLI, Schrank.

Is extremely common and often occurs in large clusters.

#### 7. LIMNIAS ANNULATUS, Cubit.

I have only come across this species once, in water taken from a gumlah in my orchid house, but on that occasion I found plenty of specimens.

On the same date, January 21st, 1889, and in the same water, I found one specimen resembling *annulatus*, but differing from it in having the ridges very wide apart, i. e., more than  $\frac{1}{1000}$ ". The ridges were not so decided as in *annulatus*, but still plainly visible, the antennæ were very short and not prominent in retraction. The tube was transparent, but far more covered with debris than the tube of *annulatus* usually is.

#### 8. CEPHALOSIPHON LIMNIAS.

Several specimens were seen, December 9th, 1888, but it is far from common in these Entally tanks.

#### 9. ŒCHISTES STEPHANION, n. sp., Pl. XX, Fig. 2.

It differs from most *Œchistes* in having a very small corona, the diameter of which is not more than half that of the body. The chin is very prominent, the distance from its tip to the upper wreath being almost as great as the breadth of the corona itself. The cilia of the secondary wreath are larger and stronger below the chin than above it, and the outline of the margin on which they are situated is very clear and sharply defined. Immediately below the lowest point of the wreath are situated the ventral antennæ, which are very short and inconspicuous, the setæ on them being with difficulty distinguished from the lowest cilia, with which they are almost in the same line. By watching the head of the *Œchistes*, when closed, very carefully with a high power (900 diameters), I saw what I take to be the dorsal antenna, which, as the animal unfolded, I was able to follow to their position as minute pimples on the dorsal side of the neck at the edge of its upper fold just at the bottom of the corona. The jaws are many-toothed, the gastric glands round and clear. The substance of the body is granular, somewhat opaque, far more so than in most Rotifers; owing to this opacity the vascular system is seen with difficulty. The cloacal aperture is situated half way down

the side. It is a curious fact that, though far above the top of the tube, the mouth of the cloaca, when ejecting matter, was raised and projected just as is done by those species which have long tubes in order to eject the fæcal matter over the top of the tube. The foot is long; when fully extended more than twice the length of the body: the lower portion is generally wrinkled. The tube is very short. In habit the creature is bold, expanding freely and rarely retracting, indifferent to sharp taps on the glass slip or to movements of it. It resembles *Æ. serpentinus*, but the foot is comparatively much shorter, and, though I looked carefully, I could see no horns or hook. It differs from other *Æchistes* in the smallness of the corona, the position and small size of the ventral antennæ, and the very short tube. It is rare.

#### 10. MEGALOTROCHA ALBOFLAVICANS.

Very common. I have found it swarming at all seasons. There is considerable variety in shape and size, the most striking form being one in which the body is very large and inflated, the viscera having the appearance of being hung in the centre of a crystalline vase. In such specimens the ringed appearance of the body as shown in Ehrenberg's figures is very marked. I note that Hudson has not drawn these rings in the plates in his book, though my own experience is that they are more or less visible in all our Indian specimens. I noticed some clusters in which the epidermis at the base appeared spotted, but with a higher power it could be seen that this appearance was due to the presence of fine short spines or projections apparently of the same substance as the epidermis. This spined epidermis remained as a sort of sheath or empty skin when by pressure the cluster was broken up. In these specimens the gastric glands were larger and more prominent than in the normal type. Some specimens, apparently full grown, for they had eggs in the cluster, were only  $\frac{1}{80}$ " in length; the larger clusters contained specimens  $\frac{1}{12}$ " long. Great as is the difference in size and shape I hesitate to divide them into different species as there were intermediate forms which seemed to link them all together. Further and more careful study may, however, show points of difference which I have overlooked.

The so-called white opaque spots are, in our Indian species, as seen by direct illumination brownish green by daylight, brown by gaslight. They are in most cases granulated in structure but in many there were clear spaces, sometimes two or more clear spaces in one spot. As I have never seen British specimens I cannot say whether this is a peculiarity; I find no mention of it either in Pritchard or in Hudson and Gosse.

The male of this species has not, I believe, been previously observed. I met with several specimens in the month of February. They were

moving in and out of clusters of the female, but I did not see actual connection. There is a certain amount of resemblance to the male of *Lacinularia*, the chief difference being the presence of a very large, clear, circular space situated in front of the sperm sac which had all the appearance of a contractile vesicle, though I did not see any contraction. The body is cylindrical with a foot projecting from the lower side. The foot glands are very large; the large nervous ganglion has branches to the antenna and to the two eyes, and one proceeding backwards embracing the top of the contractile vesicle. The integument, which is very transparent, occasionally takes the ringed appearance noted above as occurring in the female. There is a regular network of muscles (these are not clearly shown in the figure). The cilia surrounding the head are large, setting up a strong current. The length is  $\frac{1}{100}$ ", the breadth  $\frac{1}{200}$ ".

## Order II. BDELLOIDA.

### Family III. Philodinadæ.

I have come across several different species of this family, but have not been able to differentiate them with satisfaction to myself. I note here those only about which I feel a tolerable amount of certainty.

#### 11. PHILODINA CITRINA, Ehrenberg.

Fairly common at all seasons.

#### 12. PHILODINA HIRSUTA, (P), Pl. XX, Fig. 4.

This species is extremely common, and may be the *P. hirsuta* mentioned by Pritchard. There are fine hair-like spines all over the surface of the body, but the colour is not pale yellow, nor is the foot "prolonged by dorsal spines." The antenna is long and straight. The distinction between stomach and intestine is very clearly marked, and the latter is large. Two clear round (salivary) glands are very noticeable. It is very common, and is almost always attached to the stems of *Vorticella*, *Epistylis*, &c. It apparently leads a very sedentary life, for I have had specimens under observation for hours without their moving from their attachment. The contraction of the stem to which they have fixed themselves does not seem to disturb them, and, as soon as it uncoils, they unfold their wheels even before the *Vorticella* or *Carchesium* has opened out. I have often seen a couple attached on each side of the stem of a *Vorticella* just below the bell, and sometimes more than two. The fine hair-like spines are variable both in length and position, in

some cases covering the whole body, in others noticeable only on parts, but they are never absent from the greater part of the body.

13. ROTIFER VULGARIS, Schrank.

Here, as elsewhere, deserves its name.

14. ROTIFER MACROCEROS, Gosse.

Many specimens seen.

15. ROTIFER MENTO, n. sp., Pl. XX, Figs. 5 & 5, *a*.

It is with much hesitation that I describe this species, for when I mentioned to a microscopist of considerable experience that I had found a *Rotifer* inhabiting a tube, he smiled incredulously and said that I must either have been mistaken or that the *Rotifer* had made use of a tube built by some other creature. However, as its other characteristics are, it seems to me, sufficient to mark it as a new species, I shall describe them first. The characteristic which is the most striking on casual observation is the very distinct and projecting chin, with the buccal funnel running down from it in a way that reminds one of a *Melicerta*. The corona is small; the dorsal antenna very long and mobile; the frontal column is thick, short, and stout, with the appearance of a hook at its upper end; the eyes are round and bright and of a moderate size; the jaws have two teeth; the body is deeply fluted and wanting in transparency, so that the intestines were not very easily made out. It is viviparous: a young one was seen in the body of one specimen which must have been nearly as long as its parent; the wreath of the unborn rotifer was often in motion, though I did not, at any time, observe the jaws move. With relation to the tube; I have seen at different times over a dozen specimens of this species. (In all cases the water was taken from the same tank.) Every specimen except one was inhabiting a tube, and these tubes were all of the same character and all small in comparison to the size of the creature. The tube resembled that of an *Echistes*, its substance appeared to be transparent, but it was so thickly covered with foreign matter that it was practically opaque. The first specimen I had under observation for nearly six hours and it did not leave its tube. I turned the piece of weed over, then tore the tube off the weed, and, though the *Rotifer* was now able to swim about dragging its tube after it, it did not leave its hold. Finally, I crushed the tube, and the *Rotifer* then swam off; and I was able to see that it had the foot of its genus. When disturbed the *Rotifer* contracted and curled itself into the tube. This was not a mere contraction of the body, but it took

a distinct curve which enabled it to fit itself into the tube, so that, short as the latter is, the whole body of the rotifer is protected by it. This fact seems to me to go far towards proving that the rotifer is accustomed to live in a tube, though whether it makes its own tube or occupies empty tubes made by other creatures, I am not in a position to decide.

Length about  $\frac{1}{16}$ ". It is rare.

16. *ACTINURUS OVATUS*, n. sp., Pl. XX, Figs. 6 & 6, a.

Though differing in some particulars from the diagnosis of this genus as given in Hudson and Gosse's book, it can belong to no other. It has the extreme length and tenuity of form, the joints of the long and slender foot telescope into one another without sensible increase of diameter; the eyes are two, situated in the frontal column; the teeth are two, diverging. But in complete contraction the shape of the body does change. The joints of the foot fit into one another and may be drawn back right into the body without causing it to bulge, but the body itself is often lessened in length and increased in breadth till it becomes almost globular in shape. In this it resembles the genus *Rotifer*.

There is only one other known species of this genus, *Actinurus neptunius*. From this the species I am describing differs in the characteristic just mentioned of the contractility of the body. It also differs in the shape of the body, which is not cylindrical but wider posteriorly; viewed dorsally it is seen to be nearly twice as wide at the hinder end of the body as it is at the neck. A side view shows that the back rises in almost a straight line from the neck to near the extreme end of the body, where it suddenly falls to the foot. The ventral surface also is not flat but bulges slightly. When extended to its fullest, the length of the body is about three times its breadth, in *A. neptunius* it is about eight times as great.

The eyes are two, small, near the summit of the frontal column; the corona small, constantly protruded, and in constant motion. The mastax is not far from the corona, and has two gastric glands fairly large and visible. The digestive canal is perfectly straight when the creature is fully extended, and there is a clear distinction between the stomach and the intestine. The cloaca is situated at the bottom of the second joint of the foot. The spurs are small, not two-jointed, and the toes very long, often recurved. The surface of the body is deeply corrugated longitudinally, but in some specimens is very transparent and the viscera can easily be distinguished. These do not nearly fill the body cavity and strong muscles may be seen which assist in the contraction. I was unable to make out the vascular system.

In very many of the specimens there were living young in the

body cavity of their parents. In many cases, the young ones were longer than the length of their progenitor, and the long foot might be seen moving about, now drawn back into the body, and now extended to a considerable length around the viscera. The mastax and, in more than one instance, the cilia were in constant motion.

The frontal column when extended fully is tipped with cilia which vibrate actively. It was only on rare occasions, though, that I was able to see them, as they seemed to be rarely extended.

The habit of this *Actinurus* differs under different circumstances. As usually seen it is in constant motion, creeping actively or swimming over the field of view. But on one occasion I had enclosed a small Lemna leaf and the *Actinuri*, under the cover glass, took their places under this, fastening themselves well underneath, but so that their bodies projected when they were fully extended. On this occasion I was enabled to get a very satisfactory view of the organs and internal arrangement, though, owing to the thickness of the leaf, I could not use a high power.

There is one point on which I speak with some hesitation. I noticed in one specimen that there was only one tooth on one ramus and two on the other. I examined this specimen very carefully and several others also with a high power (750 diameters), and in several of the latter observed the same. In others I thought I could see the two teeth on both rami. In *Philodina erythrophthalma* an unequal number of teeth has been observed by Hudson, but in no species, as far as I know, has only one tooth been seen. But in several instances the one tooth, with the minute ridging parallel to it, was so very clear that I do not think I can have been mistaken.

The size of an average specimen when fully extended is  $\frac{1}{16}$ " to  $\frac{1}{20}$ " of which the body is about  $\frac{1}{75}$ " and the foot  $\frac{1}{25}$ ", the breadth of the body at its widest  $\frac{1}{100}$ ". Contracted the same specimen would be about  $\frac{1}{100}$ " long by  $\frac{1}{125}$ " wide, but there is considerable variation in size.

### Order III. PLOIMA.

#### Sub-order ILLORICATA.

#### Family X. Notommatadæ.

##### 17. NOTOMMATA ANSATA, Ehrenberg.

First seen, December 14th, 1888. Not uncommon.

##### 18. NOTOMMATA TRIPUS, Ehrenberg.

Common.

19. *FURCULARIA FORFICULA*, Ehrenberg.

Seen in water from the Botanical Gardens.

20. *FURCULARIA LONGISETA*, Ehrenberg.

The first specimen I saw had toes very little longer than the body. Other specimens obtained from the Botanical Gardens were nearer the normal.

21. *DIGLENA FORCIPATA*, Ehrenberg.

Common.

## Sub-order LORICATA.

Family XI. *Rattulidæ*.22. *RATTULUS TIGRIS*, Müller.

Only one or two specimens seen.

Family XII. *Dinocharidæ*.23. *SCARIDIUM LONGICAUDUM*, Ehrenberg.

Common. In the specimens first seen the posterior dorsal surface had not the sharp, clear-cut projection shewn in the figure in Hudson and Gosse's book, but was rounded as in Ehrenberg's figures. I afterwards came across specimens in water from the Botanical Gardens which had the sharp projection. At a later period, in water from the Entally tanks, I found it in great profusion with rounded projections. One specimen observed had inside it an egg covered with spines.

24. *STEPHANOPS DICHTHASPIS*, n. sp., Pl. XX, Fig. 7.

In water from the Museum tank I came across this pretty little species, and it was fairly plentiful. The lorica is ovate, prolonged behind into a shield, which is deeply notched in the centre, and extends as far as the second joint of the foot. The neck is about half the breadth of the body and has a distinct shoulder. The occipital shield is semicircular, as broad as the body, and through it the head can be seen to have an oval, not peaked shape, with its eyes very wide apart. It approaches *S. lamellaris* and *S. muticus*, but differs from both in the shape of the neck and of the body, and especially in the prolongation of the shield behind. Length  $\frac{1}{16}$ " to  $\frac{1}{8}$ ".



Family XIII. *Salpinadæ*.

I have had some difficulty in distinguishing between the species of this family, as different specimens of the same species differ greatly from one another.

25. *SALPINA BREVISPINA*, Ehrenberg.

Is very common.

26. *SALPINA EUSTALA*, Gosse.

Not uncommon. In some the alvine spines were only slightly incurved; in one the lumbar spine was irregular in shape, having a wavy appearance, and the sinus above the pectoral spine was less marked and less deep than usual.

27. *SALPINA MACRACANTHA* (?), Gosse.

The anterior and posterior ends of the ventral side of the lorica were deeply excised, the spines, lumbar and alvine, were long, and in size and shape the specimens answered to the description and to the figures in Hudson and Gosse's work, but the surface of the lorica was most plainly stippled, though in the work mentioned it is expressly stated that the lorica surface is not stippled. Many specimens were examined and they all had the stippling.

28. *SALPINA*, sp., Pl. XXI, Figs. 8 & 8a.

A fourth species seems to be intermediate between *S. macracantha* and *S. brevispina*, but it is so variable that I hesitate to make a new species of it. Its most obvious distinction from *S. brevispina* is its size, and, as I have had both specimens under observation at the same time, I think this may be of some weight, though size by itself is probably not of much value as a specific differential in our Indian species, which exhibit a tendency to run either larger or smaller than their European congeners. The sinus between the lumbar and alvine spines is not circular, but distinctly angled; Ehrenberg's figure of *S. brevispina*, however, has a somewhat angled sinus. The shell is narrower than Gosse draws it and has no bulge on the ventral surface just before the anterior opening, but Ehrenberg's figure has not these characteristics. The most important point of distinction is that the lumbar spine is a distinct spine, but this varies, for in some it is as long as in *S. macracantha*, and in others quite short, though never as short as in *S. brevispina*. Had I not had this species and *S. brevispina* under the microscope at the same time, I should have thought they were the same. It is as large as *S. macracantha*, but the spines are not usually as long, they are never incurved, and the

posterior ventral surface is not excised. It is very common. Its length is about  $\frac{1}{16}$ ".

#### Family XIV. *Euchlanidæ*.

##### 29. *EUCHLANIS MACRURA*, Ehrenberg.

Not uncommon. It may be worth noting that one specimen was observed with well defined setæ on the foot. A few minutes afterwards it was seen and the setæ had gone, though there had been no disturbance of the slide or cover glass to account for this loss. If broken off they must have been broken by the creature itself as it swam about; it had plenty of water to swim in.

#### Family XV. *Cathypnidæ*.

##### 30. *CATHYPNA LUNA*, Ehrenberg.

Very common.

##### 31. *MONOSTYLA CORNUTA*, Ehrenberg.

A very small specimen seen, total length only  $\frac{1}{16}$ ".

##### 32. *MONOSTYLA QUADRIDENTATA*, Ehrenberg.

Not very common.

I obtained some specimens from the Museum tank on December 23rd, 1888 closely resembling this species, especially in having the typical horns. They differed, however, in the following points; the mallei were not shouldered, nor was the outline of the claws wavy, the horns also were straight, not curved. In a specimen killed with osmic acid the points of the dorsal and ventral plates were very distinct and were joined by a membrane. Length of lorica  $\frac{1}{30}$ ", total length  $\frac{1}{16}$ ".

##### 33. *MONOSTYLA BULLA*, Gosse.

Not common.

#### Family XVI. *Coluridæ*.

##### 34. *COLURUS CAUDATUS*, Ehrenberg.

The only specimen seen was much larger than the British species apparently is. It was, too, rather longer in proportion to its breadth.

##### 35. *METOPIDIA LEPADELLA*, Ehrenberg.

Only a few specimens seen; the one drawn by me was only  $\frac{1}{16}$ " long.

36. *METOPIDIA SOLIDUS*, Gosse.

Very common. I found it, on one occasion, teeming in water which had been standing for many days, and in which *Paramæcia* swarmed.

37. *METOPIDIA TRIPTERA*, Ehrenberg.

Common.

38. *METOPIDIA TORQUATA*, n. sp., Pl. XXI, Figs. 9 & 9a.

The most striking characteristic is the stippling of the shell, which is very slight, except around the anterior opening, to which it gives the appearance of a collar. It differs from *M. solidus*, also, in being much more oval in shape, in having a larger anterior opening, and in being more deeply incised on the anterior ventral surface. It differs from *M. lepadella* in its size, it is more than twice as big, and in its flatness, in which it resembles *M. solidus*, and in the shape of the openings both in front and behind. Length  $\frac{1}{160}$ ".

39. *METOPIDIA ANGULATA*, n. sp., Pl. XXI, Fig. 10.

This pretty little form has a very distinctive shell. Seen dorsally the lorica curves outwards from both the anterior and posterior openings to meet in an angular point, the hinder curve being shorter than the front one. A stippled collar is also very evident, as are the two horns. Two contractile vesicles were seen in active operation. I did not see the frontal hook, so that possibly the species is not a *Metopidia*. The two eyes were small and inconspicuous. Length of lorica  $\frac{1}{320}$ ".

Family XVII. *Pterodinadæ*.40. *PTERODINA INTERMEDIA*, n. sp., Pl. XXI, Fig. 11.

The lorica is inflexible, nearly circular, and where *P. mucronata* has a sharp point this species has a semicircular projection. Slight unevenness of frontal outline occurs in *P. patina*, but in this there is a very distinct and regular projection. The surface is stippled and bosses are visible though not conspicuous. The gastric glands are long, broad, and rounded. Foliation is conspicuous. Length of lorica  $\frac{1}{120}$ ".

41. *PTERODINA*, n. sp. ?

The peculiarity of this species (?) is its internal organization. Only one specimen was seen. It resembled *P. patina* in shape, &c., but it had only one gastric gland on the right side and this sloped downwards

round a clear space which I take to be a contractile vesicle, though I saw no contraction. The stomach is on the opposite side and the intestine below behind the foot. If this is not really a species, its internal arrangement differs most curiously from the type form.

### Family XVIII. Brachionidæ.

#### 42. BRACHIONUS BAKERI, Ehrenberg.

Specimens with the broad-based lateral spines drawn by Gosse, and with the occipital spines comparatively small, are of common occurrence. Others differ greatly from this type, the lateral spines being thin from their base and curved outwards, and the central occipital spines almost as long as the lateral ones, the intermediate pair being very distinct and far from obliterate.

#### 43. BRACHIONUS URCEOLARIS, Ehrenberg.

Fairly common.

#### 44. BRACHIONUS MILITARIS.

Many specimens seen.

#### 45. BRACHIONUS LONGIPES, n. sp., Pl. XXI, Fig. 12.

The foot of this species is of extraordinary length. In a specimen measured after death the lorica was  $\frac{1}{100}$ " and the foot  $\frac{1}{75}$ " and it was wrinkled. In living specimens the foot is often extended so as to be three times as long as the lorica. In shape it resembles *B. urceolaris* from which it differs in some minor particulars. The occipital spines are somewhat more deeply cut, the pectoral edge rises considerably and has 4 undulations the two middle ones of which are slightly notched. Viewed dorsally the edge of the lorica appears round, and the spines bounding the orifice of the foot cannot be seen except through the shell; a ventral view shows that these spines are placed farther forward than the dorsal extremity of the lorica, and a side view shows that the dorsal edge of the lorica projects so that the shell from this edge to the spines is a curve inwards. The dorsal view of the foot-orifice, i. e., of the spines and the space between them, is peculiar, the inner surface of the spines being rounded and the edge between their bases having an outward curve. Length of lorica  $\frac{1}{100}$ ", of foot  $\frac{1}{75}$ " to  $\frac{1}{50}$ " total  $\frac{1}{40}$ " to  $\frac{1}{30}$ ".

#### 46. BRACHIONUS BIDENTATA, n. sp., Pl. XXI, Fig. 13.

Occipital spines six, the outer the largest, each of these having a

smaller spine or tooth springing from its ventral surface. The pectoral edge rises abruptly from the base of the outer spines and is then nearly straight. The lateral spines are very small and those bounding the foot large rounded papillæ rather than spines. Length  $\frac{1}{160}$ ", breadth  $\frac{1}{160}$ ".

#### 47. NOTEUS QUADRICORNIS.

Fairly common.

### EXPLANATION OF THE PLATES.

#### PLATE XIX.

Fig. 1. *Floscularia tenuilobata*, n. sp.,  $\times 150$ .

#### PLATE XX.

Fig. 2. *Echistes stephanion*, n. sp.,  $\times 150$ .

Fig. 3. *Megalotrocha alboflavicans*, ♂,  $\times 400$ .

Fig. 4. *Philodina hirsuta*, Pritchard?  $\times 300$ .

Fig. 5. *Rotifer mento*, n. sp.,  $\times 190$ .

Fig. 5a. The same showing the head,  $\times 525$ .

Fig. 6. *Actinurus ovatus*, n. sp.,  $\times 50$ .

Fig. 6a. The same in the retracted condition showing a living young one coiled up in its body-cavity,  $\times 100$ .

Fig. 7. *Stephanops dichthaspis*, n. sp.,  $\times 280$ .

#### PLATE XXI.

Fig. 8. *Salpina*, sp, from the side,  $\times 140$ .

Fig. 8a. Another specimen viewed partly from one side and partly from below, so as to show the ventral spines and the intervening sinus,  $\times 140$ .

Fig. 9. *Metopidia torquata*, n. sp., dorsal view,  $\times 400$ .

Fig. 9a. The same, ventral view,  $\times 400$ .

Fig. 10. *Metopidia angulata*, n. sp.,  $\times 400$ .

Fig. 11. *Pterodina intermedia*, n. sp.,  $\times 150$ .

Fig. 12. *Brachionus longipes*, dorsal view of lorica,  $\times 150$ .

Fig. 12a. " " ventral view of lorica,  $\times 150$ .

Fig. 12b. " " side view of posterior end of lorica,  $\times 150$ .

Fig. 12c. " " dorsal view of foot orifice,  $\times 850$ .

Fig. 13. *Brachionus bidentata*, n. sp., ventral view of lorica,  $\times 200$ .

N. B.—Figs. 7, 8, 8a., 9, 9a., 10, 12, 12a—c., and 13 have been drawn with the aid of the camera lucida.

XXII.—*Materials for a Flora of the Malayan Peninsula.*—By GEORGE KING, M. B., LL. D., F. R. S., F. L. S., Superintendent of the Royal Botanic Garden, Calcutta.

[Received and read July 8rd, 1889.]

As the Calcutta Herbarium contains a rich collection of Malayan plants, I propose to publish from time to time a systematic account of as many of them as are indigenous to British provinces, or to provinces under British influence. In addition to the states on the mainland of the Malayan Peninsula, these provinces include the islands of Singapore and Penang, and the Nicobar and Andaman groups. The classification which I propose to follow is that of the late Mr. Benthams and Sir Joseph Hooker. It is unlikely that, with the scanty leisure at my command, I shall be able, under several years, to complete even the meagre account of the Flora of which the first instalment is now submitted. The orders will be taken up nearly in the sequence followed in the *Genera Plantarum* of Benthams and Hooker, and in the Flora of British India of the latter distinguished botanist. The natural orders now submitted are *Ranunculaceæ*, *Dilleniaceæ*, *Magnoliaceæ*, *Menispermaceæ*, *Nymphæaceæ*, *Capparideæ*, and *Violaceæ*. The order *Anonaceæ* should have come between *Magnoliaceæ* and *Menispermaceæ*; but, on account of its extent and difficulty, I have been obliged to postpone its elaboration pending the receipt of further herbarium material. It will however, it is hoped, soon be taken up.

ORDER I. RANUNCULACEÆ.

Annual or perennial herbs or shrubs. *Leaves* alternate or opposite. *Stipules* 0, or adnate to the petiole, rarely free. *Flowers* regular or irregular, 1-2-sexual. *Sepals* 5 or more, rarely 2 to 4, usually deciduous, often petaloid, imbricate or valvate. *Petals* 0 or 4 or more, hypogynous, imbricate, often minute or deformed. *Stamens* hypogynous; anthers usually adnate and dehiscing laterally. *Carpels* usually many, free, 1-celled; stigma simple; ovule one or more, on the ventral suture, anatropous, erect with a ventral, or pendulous with a dorsal raphe. *Fruit* of numerous 1-seeded achenes, or many-seeded follicles, rarely a berry. *Seed* small, albumen copious; embryo minute. *Distrib.* Abundant in temperate and cold regions: genera 30; known species about 310.\*

\* The above diagnosis of this order (copied from Sir Joseph Hooker's *Flora of British India*) covers the entire order, which is usually sub-divided into five sub-orders or tribes. Representatives of only one of these tribes (*Clematideæ*) have hitherto been discovered in the region under review. But, as exploration of the central mountain ranges proceeds, plants belonging to one or two of the other tribes

Tribe I. *Oleatideæ*. Climbing shrubs. *Leaves* opposite. *Sepals* valvate, petaloid. *Carpels* 1-ovuled; ovule pendulous. Fruit of many achenes.

|                     |     |     |     |                       |
|---------------------|-----|-----|-----|-----------------------|
| Petals 0            | ... | ... | ... | 1. <i>Clematis</i> .  |
| Petals many, linear | ... | ... | ... | 2. <i>Naravelia</i> . |

### 1. CLEMATIS, Linn.

Woody climbers. *Leaves* opposite, simple or compound, exstipulate. *Sepals* 4 to 8, valvate. *Petals* 0. *Stamens* many. *Carpels* many, with long tails. *Ovule* solitary, pendulous.—Distrib. Temperate climates; species about 100.

1. *C. SIMILACIFOLIA*, Wall. in *Asiat. Research.* xiii, 414. *Leaves* simple, (rarely pinnate) ovate, blunt, with broad sub-cordate bases, boldly 5-nerved, coriaceous, glabrous, entire or remotely serrate, 3 to 10 in. long by 1.5 to 5 in. broad; petioles nearly as long. *Panicles* axillary, few-flowered, 6 to 12 in. long. *Flowers* 1 to 1.5 in. diam. *Sepals* 4 to 5, coriaceous, oblong, reflexed, outside dull brown tomentose, inside purple. *Filaments* linear, glabrous, the inner shorter with longer anthers. *Achenes* flat, pubescent, with broad margins and long feathery tails. A tall glabrous woody climber. DC. *Prod.*, I., 10; Bot. Mag., t. 4259; H. f. et Th. Fl. Ind., i, 6; Hook. fil. Fl. Br. Ind., i, 3. Miq. Fl. Ind., Bat. I, Pt. ii, p. 2. *C. sub-peltata*, Wall., Pl. As., Rar. I, t. 20. *C. Munroana*, Wight Ill., i, 5, t. 1. ? *C. glandulosa*, Bl., Bijdr. i, 1.

Penang, Curtis; but probably occurring also in the Central Range of mountains in the Malayan Peninsula.

2. *C. GOURIANA*, Roxb. Fl. Ind. ii, 670. An extensive climber, the young parts pubescent, adult glabrous. *Leaves* shortly petiolate, pinnate, 2-pinnate or 2-ternate, the leaflets shortly petiolulate, membranous, ovate to ovate-lanceolate, 5-nerved, sometimes sub-cordate, entire or irregularly dentate-serrate, 2 to 3 in. long by .75 to 1.75 in. broad. *Panicles* many-flowered, longer than the leaves; flowers small (.3 to .5 in. in diam.) greenish-white. *Achenes* narrowly oblong, pubescent, emarginate, with long silky tails. DC. *Prod.* i, 3; W. A. *Prod.* 2; Wight Ic. 933-4. H. f. et Th. Fl. Ind. 8; Hook. Fl. fil. Brit. Ind. i, 4. Miq. Ind. Fl. Bat. Vol. I, Pt. 2, p. 4. *C. cana* and *dentosa*, Wall. Cat. *C. javana*, DC. *Prod.* i, 7.

Not uncommon at low elevations in the Indo-Malayan region.

### 2. NARAVELIA, DC.

\*Climbing shrubs. *Leaves* 3-foliolate, terminal leaflet generally transformed into a tendril. *Sepals* 4 to 5. *Petals* 6 to 12, narrow, longer

may be found. I therefore think it better to let the diagnosis stand, than to modify it so as to include only the tribe *Oleatideæ*.

than the calyx. Achenes long stipitate, with long-bearded style.—Distrib. Two E. Asiatic species.

*N. LAURIFOLIA*, Wall. Cat. Young parts puberulous, adult glabrous. *Leaflets* broadly ovate, shortly acuminate, entire, boldly 6-nerved, 4 to 6 in. long by 2.5 to 3 in. broad. *Panicles* longer than the leaves, many-flowered; *petals* long, linear, whitish green. *Achenes* cylindric, glabrous, with stout sericeous tails. Hook. fil. et Th. Fl. Ind. i, 3; Hook. fil. Fl. B. Ind. i, 7; Miq. Fl. Ind. Bat. I, pt. ii, 2. *N. Finlaysoniana*, Wall. Cat. 468 (with diseased fruit). *Olematis similacina*, Bl. Bijdr. I, 1.

Common throughout the whole Indo-Malayan region to the Philippines.

## ORDER II. DILLENiaceæ.

Trees, shrubs or herbs, sometimes climbing. *Leaves* alternate, simple, entire or toothed (pinnatifid in *Acrotrema*), exstipulate with sheathing petioles, or more rarely with lateral deciduous stipules. *Flowers* yellow or white, often showy. *Sepals* 5, imbricate, persistent. *Petals* 5 (rarely 3 or 4) deciduous. *Stamens* many, hypogynous, many-seriate; anthers innate, with lateral slits or terminal pores. *Carpels* 1 or more, free or cohering in the axis; styles always distinct; ovules amphitropous, solitary or few and ascending, or many and attached to the ventral suture. *Fruit* of follicles, or indehiscent and sub-baccate. *Seeds* solitary or many, arillate, testa crustaceous, raphe short, albumen fleshy; embryo minute, next the hilum.—Distrib. Chiefly tropical; species about 210.

Tribe I. *Delimeæ*. Filaments thickened upwards; anthers short, cells remote oblique.

Carpel solitary ... 1. *Delima*.

Carpels 2-5 ... 2. *Tetracera*.

Tribe II. *Dilleniæ*. Filaments not thickened upwards; anthers with parallel cells.

Carpels 3; stemless herbs, leaves all radical, large... 3. *Acrotrema*.

Carpels 5-20; seeds arillate ... 4. *Wormia*.

Carpels 5-20; seeds not arillate ... 5. *Dillenia*.

### 1. DELIMA, Linn.

Woody climbers. *Leaves* parallel-veined. *Flowers* many, in terminal panicles, hermaphrodite, white. *Sepals* 5. *Petals* 2 to 5. *Stamens* many; filaments dilated upwards; cells much diverging. *Ovary* solitary, subglobose, narrowed into a subulate style; ovules 2 to 3, ascending. *Follicles* ovoid, coriaceous, 1-seeded. *Seed* with a cupular toothed aril.



1. *D. SARMENTOSA*, Linn. *Leaves* 3 to 5 in., obovate, ovate or broadly lanceolate, obtuse or acute, quite entire, serrate or crenate, appressed pilose; both surfaces scabrid; nerves 9 to 11 pairs, straight, ascending, prominent: length 2·5 to 3·5 in., breadth 1 to 2 in., petiole ·4 to ·5 in. *Flowers*  $\frac{1}{4}$  to  $\frac{1}{3}$  in. in diam., in tomentose or pilose spreading panicles that are often leafy. *Sepals* reflexed. DC. Prod. i. 69; Wall. Cat. 6632; Bot. Mag. t. 3058. Miq. Fl. Ind. Bat. I, pt. ii, 7; Hook. Fl. Fl. B. Ind. I, 31. *D. intermedia*, Bl. Bijdr. *Tetracera sarmentosa*, Willd.; Roxb. Fl. Ind. ii. 645. *Leontoglossum scabrum*, Hance in Walp. Ann. iii. 812.

Var. 1. GLABRA; fruit glabrous.

Var. 2. HEBECARPA; fruit hairy. *D. hebecarpa*, DC. Prod. i, 70; Deless. Ic. Sel. t. 72; Wall. Cat. 6633. *D. intermedia*, Blume. *Davilla hirsuta*, Teysm. et Binn. *Delimopsis hirta*, Miq.

2. *D. LEVIS*, Maingay MSS. *Leaves* oblong-lanceolate to narrowly elliptic, acute, entire, the base cuneate or rounded; nerves 8 to 9 pairs, ascending, prominent; upper surface smooth, shining; the lower puberulous; neither of them scabrid; length 5 to 7·5 in., breadth 2 to 3·5 in., petiole ·8 in., broad. *Flowers* ·5 in. in diam., in narrow tomentose leafless panicles longer than the leaves. *Sepals* reflexed.

Malacca, Maingay No. 10. · Collected only by the late Dr. Maingay.

## 2. TETRACERA, Linn.

Climbing shrubs or trees, smooth, scabrid, or pubescent. *Leaves* with parallel lateral veins. *Flowers* in terminal or lateral panicles, hermaphrodite or partially 1-sexual. *Sepals* 4 to 6, spreading. *Petals* 4 to 6. *Stamens* many, filaments dilated upwards, anther-cells distant. *Carpels* 3 to 5; ovules many, 2-seriate. *Follicles* coriaceous, shining. *Seeds* 1 to 5, with a fimbriated or toothed aril.—Distrib. All tropical; species about 25.

1. *T. ASSA*. DC. Prod. i. 68. Young branches striate, pubescent or sub-strigose. *Leaves* 2 to 5 in. long, ovate-lanceolate, acuminate, obscurely sinuate or serrate, glabrous except the nerves beneath. *Panicles* axillary and terminal, shorter than the leaves, few-flowered. *Follicles* several-seeded. W. and A. Prod. 5; Hassk. Pl. Rar. Jav. 177. Hook. fil. and Th. Fl. Ind. i, 63; Hook. fil. Fl. B. Ind. I. 31; Miq. Fl. Ind. Bat. I, Pt. ii. 8.

Common throughout Indo-Malaya, at low elevations.

2. *T. EURYANDRA*, Vahl. Symb. iii, 71. Young branches tomentose. *Leaves* rigid, 3 to 4 in. long, oblong or obovate-oblong, entire or obscurely sinuate, above glabrous except the midrib, below minutely tomentose when young. *Panicles* terminal and axillary, shorter than the leaves,

few-flowered. *Follicles* several-seeded. DC. Prod. I, 68: Roxb. Fl. Ind. ii, 646; H. f. et Th. Fl. Ind. i, 63; Hook. fil. Fl. Br. Ind. I, 32: Miq. Fl. Ind. Bat. Vol. I, pt. ii, 8. *T. lucida*, Wall. Cat.

Straits Settlements, at low elevations. Distrib. Moluccas and New Caledonia.

3. *T. MACROPHYLLA*, Wall. Cat. 6628. Young branches pubescent. *Leaves* broadly elliptic to obovate-elliptic, 5 to 7 in. long, margin sub-sinuate, scabrid on both surfaces. *Panicle* terminal, longer than the leaves, many-flowered. *Sepals* rotund, not ribbed. *Follicles* 1-seeded. Hook. fil. et. Th. Fl. Ind. I, 63: Hook. fil. Fl. Br. Ind. I, 32; Miq. Fl. Ind. Bat. Vol. 1, pt. ii, 8.

Straits Settlements, in tropical forests. Distrib. Sumatra.

4. *T. GRANDIS*, King, n. sp. A large tree. Young branches and inflorescence shortly velvety-tomentose. *Leaves* large, coriaceous, broadly elliptic, rarely slightly obovate, the apex truncate and minutely apiculate; the edges obscurely crenate or undulate toward the apex, entire below, recurved when dry; the base rounded or slightly narrowed: upper surface scabrous, lower minutely tomentose: nerves stout, 14 pairs, straight, erecto-patent; length of blade 8 to 10 in., width 5 to 5 in., petiole about 5 in., stout. *Inflorescence* in little-branched, lateral or terminal panicles a foot or more long. *Flowers* shortly pedunculate. *Sepals* 5, broadly ovate, sub-acute, concave, ribbed and tomentose externally, 5 in. long. *Petals* about as long as the sepals but narrower, glabrous. *Anthers* truncate, narrowed to the long slender filaments. *Follicles* with a slender curved beak.

Perak. Scortechini, No. 90b.

Said by Father Scortechini to be a very large tree.

### 3. *ACROTREMA*, Jack.

*Perennial* stemless herbs with woody rhizomes. *Leaves* large, parallel-nerved, with sheathing deciduous stipules. Scape short axillary, bracteolate. *Flowers* large, yellow. *Sepals* 5. *Petals* 5. *Stamens* numerous, in 3 bundles which alternate with the carpels; filaments filiform, anthers erect, with longitudinal porous dehiscence. *Carpels* 3, slightly cohering: styles subulate, recurved; ovules 2 or more. *Fruit* of 3 irregularly dehiscent follicles. *Seed* with a membranous aril; the testa crustaceous, pitted.—Distrib. ten species, of which 8 are endemic in Ceylon, 1 Peninsular-Indian, and 1 Indo-Malayan.

*A. COSTATUM*, Jack in Mal. Misc. ex. Hook. Misc. ii, 82. Whole plant covered with stiff rufous or golden hairs, especially when young. *Leaves* obovate, the margins dentate-ciliate; the base narrowed, sagittate; upper surface strigose, often blotched with white, petiole short. *Racemes*

shorter than the leaves, 8 to 10-flowered, setose; bracteoles minute, lanceolate. *Flowers* an inch in diam. *Stamens* about 15. Hook. fil. and Th. Fl. Ind. i, 65; Hook. fil. Fl. Br. Ind. I, 32; Miq. Fl. Ind. Bat. Vol. I, Pt. ii, 10. *A. Wightianum*, W. and A. Prod 6: Wight Ill. t. 9.

Straits Settlements; in damp shady spots at elevations of 500 to 2500 feet. Common.

#### 4. WORMIA, Rottb.

Trees, sometimes lofty; or shrubs. *Leaves* broad, sub-coriaceous; lateral nerves many, strong, parallel; petioles usually with deciduous stipular wings. *Flowers* large, in terminal racemes or panicles. *Sepals* 5. *Petals* 5. *Stamens* indefinite, in several series, nearly free; anthers linear, erect, cells opening by 2 pores. *Carpels* 5 to 10, scarcely cohering in the axis; ovules numerous. *Fruit* of indehiscent or follicular 3- or more-seeded carpels. *Seeds* with a fleshy aril. Distrib. Tropical Asia and Australia, and one in Madagascar; species about 9.

Sect. I. *Capellia*, Blume (genus). Inner row of stamens much longer than the outer and arching over them.

1. *W. SUFFRUTICOSA*, Griff. Notul. iv. 706; Ic. iv. t. 649, f. 1. A small tree. Young parts floccose. *Leaves* with short, broadly winged, petioles; broadly elliptic or sub-obovate-elliptic, blunt or acute, dentate, glabrous except the 12-20 pairs of nerves which are sparsely pilose beneath; length of blade 7 to 9 in.; breadth 4 to 5·5 in.: petiole ·5 to 1·5 in. *Racemes* about as long as the leaves, leaf-opposed; pedicels ·5 to 1 in. long. *Flowers* 3 to 4 in. in diam., yellow. *Sepals* broadly ovate, nerved, glabrous. *Petals* obovate, crenulate. *Carpels* 5 to 7, 3 to 5-seeded. Hook. fil. Fl. Br. Ind. I, 35. *W. excelsa*, H. f. and Th. Fl. Ind. I, 67 (not of Jack). *W. subsessilis*, Miq. Fl. Ind. Bat. Suppl. i. 618; Ann. Mus. Lugd. Bat. i. 315, t. 9.

Malacca, Singapore; extends to Sumatra, Banka, Borneo and probably to other islands of the Archipelago.

2. *W. OBLONGA*, Wall. A tree. Young branchlets thin, sparsely tomentose, the old glabrous. *Leaves* rather distant, on moderate channelled (not winged) petioles, oblong to elliptic, acute at base and apex, entire or distantly serrate or sub-serrate, nerves 9 to 12 pairs: length of blade 6 to 8 in., breadth 3 to 3·5 in.; petiole 1·5 in. *Cymes* terminal or leaf opposed, few-flowered, shorter than the leaves, tomentose; pedicels about 1 in., thickened above, tomentose. *Flowers* 3 to 5 in. in diam. *Sepals* ovate-rotund, tomentose externally. *Petals* obovate, entire, veined, yellow. *Carpels* 8 to 10. H. f. & Th. Fl. Ind. i, 67; Hook. fil. Fl. Br. Ind. i, 35; Miq. Fl. Ind. Bat. Vol. 1, pt. ii, p. 11.

Straits Settlements in more or less dense forest. Distrib. Sumatra

Sect. II. *Euvormia*. Filaments all erect and nearly equal in length.

3. *W. PULCHELLA*, Jack. Mal. Misc. ex. Hook. Comp. Bot. Mag. 1, 221. A shrub. Young parts glabrous. *Leaves* on short narrowly winged petioles, obovate or obovate-oblong, obtuse, entire, truncate or retuse, sometimes mucronate, thickly coriaceous, glabrous; nerves 5 to 7 pairs; length of blade 2.5 to 4 in., breadth 1.5 to 2.5 in.; petiole .75 in. *Flowers* solitary or in small cymes, axillary or terminal, 2 in. in diam.; pedicels 2 in. long. *Sepals* broadly ovate, glabrous. *Petals* ovate. *Carpels* about 5. *Seeds* few, with pulpy arillus. H. f. and Th. Fl. Ind. I, 68: Hook. fil. Fl. Br. Ind. I, 36; Miq. Fl. Ind. Bat. Vol. I, Pt. ii, p. 11.

Perak and Malacca; at elevations under 1,000 ft. Distrib. Sumatra.

4. *W. MELIOSMÆFOLIA*, King, n. sp. A small tree, the young parts and leaf-petioles softly fulvous-tomentose. *Leaves* crowded near the apices of the branches, coriaceous, obovate-lanceolate to obovate-elliptic, acute or acuminate, entire or minutely and remotely serrate, base acute, glabrous above except the 14 to 18 pairs of spreading pubescent nerves, under surface minutely tomentose; length of blade 5 to 8 in., breadth 3 to 4 in., petiole about 1 in. *Flowers* about 3 in. in diam., axillary, solitary, on slender tomentose peduncles 2 in. long, or in few-flowered linear-bracteolate cymes; peduncles 1 in. long. *Sepals* ovate-oblong, velvety-tomentose externally, glabrous internally. *Petals* oblanceolate, pale yellow, veined, wavy. *Stigmas* about 12, linear, recurved. *Follicles* with several compressed, arillate seeds. *Dillenia meliosmæfolia*, Hook. fil. & Th. Fl. Br. Ind. I, 36.

Malacca, Perak.

Originally described as a *Dillenia* by Sir Joseph Hooker who had not seen the fruit.

5. *W. SCORTECHINII*, King, n. sp. A tree 60 to 70 feet. Branchlets thick, scarred, puberulous or glabrous. *Leaves* coriaceous, obovate-oblong, shortly acuminate, undulate-crenate, narrowed to the petiole: upper surface shining, glabrous except the midrib and nerves which are minutely pubescent as is the under surface: nerves prominent on the under surface, 26-30 pairs each ending on the margin of the leaf in a tuft of hairs; length of blade 4 to 6.5 in., breadth 2 to 3; petiole .5 to 2 in., winged and expanded at the base. *Cymes* supra-axillary, sub-terminal, dichotomous, pubescent; bracteoles oblong, .3 in. long; pedicels .25 in. long. *Flowers* when expanded about 1 in. broad. *Sepals* 5, puberulous externally, broadly ovate, coriaceous. *Petals* 0. *Anthers* equal in length to the filaments, slightly hairy. *Ovaries* 3 to 5, usually 4. *Ripe fruit* unknown.

Perak. Father Scortechini.

Collected only by Scortechini who left a MS. description of it under the name *Wormia apetala*. But, as that name is pre-occupied by a species of Gaudichaud, I have rechristened it after its lamented discoverer. In his description Father Scortechini says that, although he opened many buds, he never could find any trace of petals. In stamens this agrees with the *Euwormia* section of *Wormia*: but whether it is really a *Wormia* and not a *Dillenia* cannot be settled until ripe fruit is found.

*Species of which flowers are unknown.*

6. *W. KUNSTLERI*, King, n. sp. Young branches thick, rugose pubescent. *Leaves* on channelled petioles, obovate-oblong, blunt, the base narrowed, slightly sinuate-crenate, glabrous except the pubescent midrib and 18 to 22 pairs of nerves: length of blade 6 to 8 in., breadth 3.5 to 4 in.; petiole nearly 2 in. *Cymes* leaf-opposed, few-flowered, tomentose; peduncles about 1 in. *Sepals* broadly ovate, glabrous, thick. Young seeds arillate.

Perak. King's collector No. 5905. The only specimens have unripe fruit.

## 5. *DILLENNIA*, Linn.

Characters of *Wormia* except that the flowers are more often solitary and are sometimes white; the carpels are rather more numerous, are never dehiscent, cohere in the axis, and are enveloped in the thickened accrescent calyx; while the seeds are exarillate.

1. *D. INDICA*, Linn. A tree: the young branches tomentose. *Leaves* crowded at the ends of the branches, coriaceous, lanceolate or ovate-lanceolate, sharply serrate, glabrous above, pubescent beneath especially on the 30 to 40 pairs of stout nerves: length of blade 8 to 12 in., breadth 3 to 4 in., petiole 1 to 1.5 in., channelled, sheathing at the base. *Flowers* 6 to 9 in. in diam., solitary, axillary, on short tomentose pedicels 2 to 3 in. long. *Sepals* orbicular, concave, fleshy. *Petals* white, obovate-oblong, undulate. Inner *stamens* longer than the outer and arching over them. *Pistils* about 20; the stigmas lanceolate, recurved, radiating. *Carpels* 1-celled with many reniform hairy seeds. Ham. Linn. Trans. XV, 99: H. f. and Th. Fl. Ind. I. 69, Hook fil. Fl. Br. Ind I, 36; Martelli in Malesia III, 154. *D. speciosa*, Thunbg, Linn. Trans. i, 200: DC. Prod. i, 76; Roxb. Fl. Ind. ii, 651; W. & A. Prod. 5; Wight Ic. 823; Miq. Fl. Ind. Bat. Vol. I, Pt. ii, 11. *D. elliptica*, Thunbg. Linn. Trans. I, 200.

Tropical Forests of the Indo-Malayan Region. Distrib. India, Ceylon.

2. *D. OVATA*, Wall. A tree, the branchlets as thick as a quill, softly tomentose. *Leaves* coriaceous, ovate or obovate-rotund, apex sub-

acute, rounded or emarginate; minutely denticulate or sub-entire; glabrous above except the 16 to 20 pairs of sub-horizontal pubescent nerves, fuscous-tomentose beneath; blade 3.5 to 7 in. long by 2.75 to 3.5 in. broad, petiole about 1 in. tomentose. *Flowers* solitary 6 to 8 in. in diam.; peduncles stout, tomentose, 2.5 in. long. *Sepals* reflexed, ovate, concave, thick, minutely adpressed-tomentose in the middle externally, the margins and inner surface glabrous. *Petals* obovate, yellow, veined. *Stigmas* about 15, long, linear, recurved. H. f. and Th. Fl. Ind. I, 70; Hook. fil. Fl. Br. Ind. I, 36; Miq. Fl. Ind. Bat. Vol. 1, Pt. ii, 12.

Penang and Perak. In tropical forests.

I have seen no ripe fruit of this, nor have I found any description of the ripe fruit. I am therefore unable to say whether the sepals and seeds are those of a *Dillenia* or a *Wormia*. This comes near *D. aurea*, but the panicles are much laxer and the petioles longer.

3. *D. AUREA*, Sm. Ex. Bot. 93, t. 92. A tree, the branchlets as thick as the little finger, glabrous, scabrid: young parts rufous-sericeous. *Leaves* obovate, blunt or acute, crenate-dentate, glabrous above except the 20 pairs of pubescent, bold, sub-transverse nerves; under surface softly puberulous: length of blade 5 to 8 in.: breadth 3 to 4.5 in.: petiole 1.25 to 2 in., sheathing at the base. *Flowers* solitary, from shortened branches, 4 to 5 in. diam.; peduncles stout, 1 in. or more. *Sepals* oblong, obtuse, concave, fleshy, adpressed-pubescent externally when young, when old glaucous. *Petals* obovate, yellow, veined. *Stigmas* about 10, linear, radiate. DC. Prodr. i. 76; Wall Cat. 6624; H. f. & T. Fl. Ind. 70. Hook. fil. Fl. Br. Ind. I, 37; Miq. Fl. Ind. Bat. Vol. I, pt. ii, 12; Martelli in Malesia III, 155. *D. ornata*, Wall. Pl. As. Rar. i, 21, t. 23: Cat. 947. *D. speciosa*, Griff. Notul. iv, 703. *Colbertia obovata*, Bl. Bigdr. 6.

Throughout the Indo-Malayan region, at low elevations.

4. *D. RETICULATA*, King, n. sp. A large tree. *Leaves* very coriaceous, obovate-elliptic, obtuse?, dentate; the base truncate, cordate; upper surface glabrous except the impressed midrib and nerves, which are pubescent; under surface pubescent, the midrib and nerves very strong; reticulations minute, very bold, arcular; nerves 32 to 36 pairs, sub-horizontal; length of blade 10 to 18 in., breadth 7 to 12 in., petiole 2 to 3 in. winged, much expanded at the base. *Cymes* lateral and terminal, short, branching, 10 to 12 flowered, pubescent; pedicels stout, bracteolate. *Sepals* thick, broadly elliptic to orbicular, 1 in. in diam., pubescent externally. *Petals* oblong, concave, 1.5 in. long. *Stamens* in many series; the outer inflexed, introrse; the inner erect and extrorse. *Pistils* about 9, puberulous; stigmas linear, radiating, ovules ex-arillate.

Perak. Father Scortechini.

*Ripe fruit* is unknown and it is possible that the seeds may be arillate. It has, however, the facies of a *Dillenia* rather than of a *Wormia*. In leaf this resembles *D. eximia*, Miq., but that plant has broader leaves much more narrowed to the base. It also resembles *D. grandifolia*, Wall., but is distinguished by its closer nerves and remarkable areolar reticulations.

Species imperfectly known.

5. *D. GRANDIFOLIA*, Wall. *Leaves* oblong-lanceolate, acute, serrate, softly hairy above, tomentose beneath; nerves about 40 to 50 pairs, transverse: length of blade 24 in., breadth 9 in.; petioles stout, 5 to 6 in. long, densely tomentose as is the midrib. H. f. & Th. Fl. Ind. I, 71; Hook. fil. Fl. Br. Ind. I, 38. Miq. Fl. Ind. Bat. Vol. I, pt. ii, 12.

Penang and Malacca.

Known only by a few imperfect specimens in Herb. Wallich. *D. eximia*, Miq., from Sumatra, is a species also known only by a few leaf specimens which I have examined. The two differ as above described and may belong to *Wormia*.

### ORDER III. MAGNOLIACEÆ.

Trees or shrubs, sometimes climbing, often aromatic, wood-tissue with glandular markings. *Leaves* alternate, quite entire or toothed, stipulate or not. *Flowers* axillary and terminal, often showy, white, yellow or red, sometimes unisexual. *Sepals* and *petals* very deciduous, hypogynous, arranged in whorls of 3. *Stamens* indefinite, hypogynous, filaments flattened or terete, free or monadelphous; anthers basifixed, adnate cells bursting longitudinally. *Carpels* indefinite, free or partly cohering in one whorl, or in several on an elongate axis; styles short or rarely long, stigmatose on the inner surface; ovules 2 or more, on the ventral suture, anatropous or amphitropous. *Fruit* baccate, or follicular, or of woody dehiscent carpels, which are sometimes arranged in a cone. *Seeds* solitary or few, sometimes pendulous from a long funicle, testa single and crustaceous, or double, the outer fleshy; albumen granular or fleshy and oily; embryo minute, cotyledons spreading, radicle short, blunt, next the hilum.—Distrib. Chiefly natives of the tropical and temperate Asiatic mountains and United States, a few are Australian; species about 80.

Tribè I. *Magnoliæ*. *Flowers* bisexual. Erect shrubs or trees. *Stipules* conspicuous, convolute and embracing the leaf-buds, deciduous. *Carpels* on an elongated axis.

Carpels not separating from the carpophore;  
dehiscing dorsally.

- Carpophore sessile, carpels closely packed.  
 Fruit, elongate, cylindric, ovules 2 ... 1. *Magnolia*.  
 „ ovoid, ovules 6 ... 2. *Manglietia*.  
 Carpophore stalked, carpels distant ... 3. *Michelia*.  
 Carpels when ripe separating from the sessile  
 carpophore and dehiscing ventrally ... 4. *Talauma*.  
 Tribe II. *Winteria*. Flowers usually bisexual. Shrubs  
 or small trees. Stipules 0. Carpels in one whorl 5. *Illicium*.  
 Tribe III. *Schinandrea*. Flowers unisexual. Climb-  
 ing shrubs. Leaves exstipulate. \*  
 Carpels of fruit capitate ... 6. *Kadsura*.

## 1. MAGNOLIA, Linn.

Trees or shrubs. *Leaves* evergreen or deciduous; buds enveloped in the convolute stipules, which are connate in pairs. *Flowers* large, terminal. *Sepals* 3. *Petals* 6 to 12, 2 to 4-seriate. *Stamens* numerous, many-seriate, filaments flat; anthers adnate, introrse. *Gynophore* sessile. *Carpels* many, imbricated on a long axis, 2-ovuled, persistent; stigmas decurrent on the ventral suture. *Fruit* an elongated axis, with persistent adnate 1-2-seeded dorsally dehiscing follicles. *Seeds* pendulous from the carpels by a long cord; outer walls of testa fleshy: albumen oily.—Distrib. Temp. N. America, temp. and trop. E. Asia and Japan; species about 16.

*M. MAINGAYI*, King, n. sp. A tree. Young branches and inflorescence densely clothed with pale shaggy hair. *Leaves* membranous, oblanceolate-oblong or obovate, acuminate, narrowed to the rounded base; upper surface glabrous, the lower glaucous, the midrib sparsely villous; nerves 16 to 20 pairs; length of blade 6 to 8 in., breadth 2.5 to 3 in., petiole .3 in. *Flowers* terminal, solitary, shortly pedunculate, buds ovoid, the stipular hood villous like the pedicel. *Sepals* 3, oblong. *Petals* about 6, of the same shape as the sepals but smaller, yellowish-white, glabrous, 1 to 1.3 in. long. *Ovaries* villous. *Ripe fruit* cylindric, 1.5 in. long by .6 in. diam.; the individual carpels ovoid, not beaked, .35 in. long, villous.

Malacca, (Maingay No. 17), Perak, Penang; in dense low forest up to 2,500 feet.

## 2. MANGLIETIA, Blume.

Trees; foliage and inflorescence of *Magnolia*. *Sepals* 3. *Petals* 6 or more, 2- or more-seriate. *Stamens* very numerous, many-seriate; anthers linear, adnate, introrse. *Gynophore* sessile. *Ovaries* many, cohering in an ovoid head; stigma decurrent on the ventral suture;



ovules 6 or more. *Fruit* ovoid; carpels persistent, dehiscent dorsally. *Seeds* as in *Magnolia*.—Distrib. Mountains of tropical Asia; species 5.

1. *M. SEBASSA*, Miq. Ann. Lugd. Bat. IV, 71. A shrub. Adult branches with pale shining bark; young tawny villous, as are the petioles and spathoid hood of calyx. *Leaves* coriaceous, oblong or oblanceolate, acute, much narrowed at the base, glabrous and shining on both surfaces, bullate; nerves 14 to 20 pairs, prominent; length of blade 11 to 14 in., breadth 4·5 to 7 in., petiole 1 in., much thickened at base. *Flowers* solitary, terminal, on villous peduncles 2 to 3 in. long. Spathoid hood densely adpressed fulvous-sericeous. *Sepals* and petals about 9, fleshy, pale yellow, from obovate to oblong, abruptly contracted into a claw at the base, nearly 2 in. long. *Stamens* with very stout filaments. *Pistils* about 20. *Ripe carpels* (*fide* Miquel) oblong, lenticellate. Miq. Fl. Ind. Bat. Suppl. 367.

Perak, Kunstler; in dense jungle, at elevations of about 1500 feet: only once collected. Distrib. Sumatra.

The specimens collected by the late Mr. Kunstler are without fruit. They agree in other respects with the Sumatran specimens on which Miquel founded the species.

2. *M. GLAUCA*, Bl. Bat. Verh. IX, 149. A tall glabrous tree. *Leaves* coriaceous, oval or obovate-oblong, slightly acuminate, the edges slightly recurved when dry, glaucescent beneath; nerves 12 to 14 pairs, not prominent; length of blade 5 to 7 in., breadth 2·5 to 3 in.; petiole ·75 to 1·5 in. *Flowers* terminal, solitary, on annulate peduncles 1 to 1·5 in. long, yellowish, about 1·5 in. long. Stipular hood broadly ovate, glabrous. *Sepals* and petals 9, greenish-yellow, oblong, sub-acute, those internal smaller. *Filaments* short. *Pistils* numerous. *Ripe fruit* ovoid, the size of a hen's egg, glabrous. *Seeds* with a red fleshy arillus. Bijdr. 8; Fl. Jav. Magnol. 22, t. 6. Miq. Fl. Ind. Bat. Vol. I, pt. 2, p. 15.

Perak at 3,000 feet. Distrib. Java.

3. *M. SCORTECHINI*, King, n. sp. A tree. The young branches, stipules and under surfaces of the leaves minutely rufous-pubescent. *Leaves* thinly coriaceous, lanceolate, narrowed to base and apex, the latter subacute; upper surface shining, reticulations minute, distinct on both surfaces; nerves about 12 pairs; length of blade 3·5 to 4 in., breadth 1·25 in., petiole ·3 to ·4 in. *Flowers* solitary, axillary, on annulated pedicels shorter than the petioles: stipular hood rufous, silky. *Sepals* and petals about 12, similar, ·5 in. long, linear-lanceolate. *Stamens* linear. *Fruit* ovoid (young ·5 in. long) on a short gynophore, rufous-pubescent. *Carpels* 6 to 8.

Perak. Father Scortechini.

The only specimens of this have unripe fruit. The ovaries have

only 1 ovule, but apparently it is a *Manglietia* and I put it into this genus provisionally. The small rufous leaves, shining on the upper surfaces, and small axillary flowers mark it as distinct from any other Indo-Malayan *Magnoliad*.

### 3. MICHELIA, Linn.

Trees. *Leaves* as in *Magnolia*. *Flowers* axillary, solitary or terminal. *Sepals* and petals similar, 9 to 15 or more, 3- or more-seriate. *Stamens* as in *Magnolia*. Gynophore stalked. *Carpels* in a loose spike, stigma decurrent; ovules 2 or more. *Fruit* a lax or dense elongate spike of coriaceous dorsally dehiscent carpels. *Seeds* of *Magnolia*.—*Distrib.* About 15 species; temp. and trop. Mountains of India.

1. *M. CHAMPACA*, Linn. A tall tree, the branchlets pubescent. *Leaves* membranous, ovate-lanceolate, acuminate, rather abruptly narrowed to the base, shining above, pale and glabrous or puberulous beneath; main nerves thin, 12 to 16 pairs; length of blade 4·5 to 9 in.; breadth 2·25 to 3·5 in.; petiole 1 to 1·5 in. *Flowers* yellow, solitary, axillary or terminal, shortly pedunculate; buds narrowly ovoid, the stipular hood silky. *Sepals* oblong. *Petals* about 15, narrowly oblong, 1 in. long. *Ripe fruit* 3 to 6 in. long: individual carpels ovoid, lenticellate, woody. DC. Prodr. i, 79; Roxb. Fl. Ind. ii, 656; W. & A. Prod. i, 6; Wight Ill. i, 13; Blume Fl. Jav. *Magnol.* t. 1, Bijdr. 7; H. f. & T. Fl. Ind. 79. Hook. fil. Fl. Br. Ind. I, 42; Miq. Fl. Ind. Bat. Vol. I, pt. ii, 16; *M. rufinervis*, DC. l. c. 79; Bl. Bijdr. 8; *M. Doldropa*, Ham. ex DC. l. c.; Don Prodr. 226; Wall. Tent. Fl. Nep. t. 3; *M. aurantiaca*, Wall. Cat., Plant. As. Rar. t. 147. *M. Rheedii*, Wight Ill. i. 14, t. 5, f. 6. *M. pubinervia*, Bl. Fl. Jav. *Magnol.* p. 14, t. 4.

In temperate forests in the Straits Settlements, but not common. *Distrib.* India.

2. *M. MONTANA*, Bl. in Verh. Bat. Gen. IX, p. 153. A glabrous tree. *Leaves* thinly coriaceous, shining, obovate or obovate-rotund, shortly and abruptly apiculate, rather suddenly narrowed to the base; nerves 10 to 12 pairs, thin, spreading; length of blade 6·7·5 in., breadth about 4 in.; petiole, slender '75 in. *Flowers* white, 1·5 in. in diam., solitary, terminal or axillary, on annulate peduncles about '5 in. long. Buds cylindric. *Sepals* and petals about 8, oblanceolate or lanceolate. *Pistils* 3 to 4. *Carpels* usually single, sub-globular, 1·5 in. long, the walls lenticellate, woody, '5 in. or more thick. Bl. Bijdr. 7, Fl. Jav. *Magnol.* p. 15, t. 5; Miq. Fl. Ind. Bat. Vol. I, Pt. ii, 17.

Perak, at low elevations. Java, on the mountains. *Distrib.* Eastern Himalaya.

Specimens from the E. Himalaya have less obovate leaves, and rather

larger flowers on longer peduncles : but in other respects they agree with the Java plant. This species is readily distinguished by its enormously large, solitary, woody carpels.

#### 4. TALAUMA JUSS.

Trees or shrubs. *Leaves* and inflorescence of *Magnolia*. *Sepals* 3. *Petals* 6 or more, in 2 or more whorls. *Stamens* very numerous, many-seriate: anthers linear, introrse. *Gynophore* sessile. *Ovaries* indefinite, 2-ovuled, spiked or capitate: stigmas decurrent. *Carpels* woody, separating from the woody axis at the ventral suture, and dehiscing so as to leave the seeds suspended from the axis by an elastic cord. *Seeds* of *Magnolia*. Distrib. Tropics of Eastern Asia, & South America: Japan. Species about 18.

1. *T. LANIGERA*, Hook. fil. & Th. Fl. Br. Ind. I, 40. A small tree. Young leaves, petioles and branches, the peduncles, outer surface of the stipular involucre enveloping the calyx, and the ovaries densely fulvous-tomentose. *Leaves* sub-coriaceous, oblong or oblanceolate, abruptly and shortly acuminate, narrowed at the base, when adult shining and glabrous except on the lower half of the midrib below; length of blade 9 to 12 in., breadth 2·5 to 4 in.; petiole 1 to 1·5 in., thickened below. *Sepals* and petals white, ovate, tomentose at the very base. *Ripe fruit* 3 to 4 in. long by 2 in. broad; the carpels glabrescent when quite ripe, beaked, 1·5 in. long.

In open forest on low hills; Perak and Malacca.

From Miquel's description of his *T. villosa*, (Fl. Ind. Bat. Suppl. 366,) that species and this must be very closely allied; and, if they are identical, Miquel's name, dating 1860, must take precedence of Hf. & T.'s, which was published in 1875.

2. *T. ANDAMANICA*, King, n. sp. A glabrous shrub or small tree. *Leaves* sub-coriaceous, oblanceolate-oblong, rarely lanceolate, the apex (usually rather abruptly) acute, below gradually narrowed to the petiole; both surfaces shining; main nerves 10 to 14 pairs, thin but prominent below; length of blade 7 to 10 in., breadth 2·5 to 3·5 in.; petiole ½ to 1 in., expanded at the base. *Flowers* solitary, sub-globose, 1·5 in. long: on thick terminal annulated pubescent peduncles 1 in. long: stipular hood of calyx glabrous. *Sepals* 3. *Petals* 6 ovate or obovate. *Ripe fruit* globose, pyriform, 1·5 in. long; the individual carpels rhomboid, 6 in. long and nearly as broad, shortly beaked: seeds ¼ in. long.

Andaman Islands, on Mount Harriet.

In leaf this closely resembles *T. Rabaniana*, H. f. and Th., but has smaller flowers and fruit. The individual carpels of this are not more than a third the size of those of *T. Rabaniana*, which are more than 1 inch long and narrowly oblong and not rhomboidal.

3. *T. MUTABILIS*, Bl. Fl. Jav. *Magnol.* p. 35, t. 10, 11, 12, fig. B. A glabrous shrub. *Leaves* oblong-lanceolate, acute at either end, slightly unequal at the base, sub-coriaceous, shining on both surfaces; nerves about 12 pairs, spreading; length of blade 5 to 8 in., breadth 2·25 to 2·75 in.; petiole ·75-8 in., thickened at the base, minutely muriculate when dry as is the midrib. *Flowers* solitary, terminal, on annulate peduncles about 1·5 in. long: stipular hood fuscous-villous. *Sepals* 3, broadly ovate. *Petals* 6, in 2 whorls, broader than the sepals, sometimes obovate, concave, connivent, passing from rosy green to reddish brown. *Ripe fruit* ovoid, 1·5 to 2 in. long, pubescent at first, ultimately glabrous: individual carpels, rhomboid, lenticellate, with blunt recurved beaks ·75 to 1·25 in. long. Korth. in Ned. Kruik. Arch. II, 98; H. f. and Th. Fl. Ind. I, 74; Hook. fil. Fl. Br. Ind. I, 40; Miq. Fl. Ind. Bat. Vol. I, pt. ii, 14: *Manglietia Candollei*, Wall. Cat. (not of Bl.).

In the Straits Settlements, in shady damp spots near water. Distrib. The Malayan Archipelago.

A very variable shrub of which Blume distinguishes 3 varieties. All the specimens I have seen from the Straits have glabrous leaves: but Blume and others describe the leaves as often pubescent or even pilose below.

4. *T. KUNSTLERI*, King, n. sp. A tree, 25 to 30 feet high; glabrous, except the peduncle and unripe carpels. *Leaves* oblong-lanceolate, acuminate at base and apex, thinly coriaceous, both surfaces shining, nerves 10 to 14 pairs, length of blade 6 to 9 in., breadth 1·75 to 2·5 in.; petiole ·5-1·25 in., slender, the base much thickened. *Flowers* terminal, solitary, on ovoid, scarcely expanding, ·85 in. long, erect pubescent annulate peduncles 1 in. long. *Sepals* 3 and petals 6 scarcely exceeding the stamens, broadly elliptic, fleshy, glabrous, waxy white. *Anthers* sessile, more than ·5 in. long. *Pistils* 6 to 8, linear, pubescent. *Ripe fruit* ovoid, pointed, 1·25 in. long and ·75 in. in diam.; individual carpels ·75 to 1 in. long, with short stout sub-terminal beaks.

Perak, in dense forest at elevations of from 3,500 to 4,000 feet.

I here subjoin a description of a new-species from Sumatra.

5. *TALAUMA FORBESII*, King, n. sp. A small tree or shrub; glabrous except the peduncles which are adpressed villose. *Leaves* oblong-lanceolate, acuminate both at base and apex, green and shining on both surfaces, thinly coriaceous, nerves 12 to 15 pairs, length of blade 4·5 to 6 in., breadth 1 to 1·5 in. *Flowers* terminal, solitary, erect, ·75 in. long, on stout peduncles. *Stipular hood* of calyx densely covered with adpressed, fulvous silky hair; buds pointed. *Sepals* and petals about the same length, white, nearly glabrous. *Ripe fruit* 1·25 in. long; the individual carpels ·6 in. long, ovate, rugose, with short terminal beak. *Seeds* 4 in. broad, by 3 in. long, the base compressed.

Sumatra, on Kaiser's Peak &c. at elevations of 5,000 to 6,500 feet. Forbes, Nos. 1853, 2066 and 2204.

This resembles *T. pumila*, but its leaves are not glaucous beneath and they have more nerves: moreover the flowers are smaller and not drooping, the petals ovate and not obovate, and the carpels are only about half the length of those of that species.

##### 5. ILLICIUM, Linn.

Evergreen aromatic shrubs or small trees. *Leaves* quite entire, pellucid-dotted. *Flowers* bi-sexual or unisexual, solitary or fascicled, yellow or purplish. *Sepals* 3 to 6. *Petals* 9 or more, 3- many seriate. *Stamens* indefinite, filaments thick: anthers adnate, introrse. *Ovaries* indefinite, 1-seriate, 1-ovuled; style subulate, recurved. *Fruit* of spreading compressed hard follicles. *Seeds* compressed, testa hard, shining; albumen fleshy. Distrib. North America, China, Indo-Malaya; species about 6.

*T. CAMBODIANUM*, Hance in Journ. Bot. 1876, p. 240. A small glabrous tree. *Leaves* opposite or in whorls of 3 or 4, coriaceous, oblanceolate or obovate-lanceolate, rarely lanceolate, acuminate, entire; length of blade 3 to 4.5 in., breadth 1 to 2 in., petiole less than 5 in. *Flowers* red to white, 4 in. in diam., on long, slender, axillary pedicels, solitary or in groups of 3 or 4. *Sepals* 3 or 4, rotund. *Petals* about 9, diminishing in size inwards, ovate-oblong, blunt. *Stamens* 9 to 13 in a single row, the filaments about as long as the anthers. *Follicles* 8 to 12, beaked, radiate. *Pierre*, Flore Forestiere de la Cochin Chine, t. 4.

Perak, in dense forests at elevations of from 3,600 to 7,000 feet.

There is some variability as to the shape and size of the sepals: sometimes they are triangular and much smaller than the petals, in other specimens they resemble the petals both in size and shape. The stamens also vary in number, but they never form more than a single row. The texture of the leaves in some plants is thin and membranous, in others almost coriaceous. It is possible there may be two species included in this.

*T. EVENIUM*, King, n. sp. A small glabrous tree. *Leaves* very coriaceous, opposite or in whorls of 3, oblanceolate or obovate-oblong, the apex with an abrupt blunt short acumen, the base elongate-cuneate, gradually narrowed to the short thick petiole; nerves undistinguishable (when dry); length of blade 3.5 to 5 in., breadth 1.25 to 2 in.: petiole .3 in. or less. *Flowers* globular, 2 in. in diam., pedicellate, solitary or in 2 to 3- flowered racemes; pedicels with a few minute bracteoles near the apex, about 1 in. long. *Sepals* and petals 8 or 9, rotund, fleshy, similar, or the former a little smaller. *Stamens* 30 to 50, in several rows,

filaments shorter than the anthers; connective of outer stamens narrow, of the inner broad. *Female flowers unknown.*

Perak, Scortechini.

This species was collected only once by the late Father Scortechini. All the flowers which I have seen are male; and, as no unisexual species of this genus has hitherto been described, I have modified the generic definition accordingly. This differs from *T. Cambodianum* in having very coriaceous leaves with shorter petioles, smaller flowers, and much more numerous stamens.

## 6. KADSURA, Kaempfer.

Climbing glabrous shrubs. *Leaves* exstipulate. *Flowers* unisexual, white, yellow or reddish, axillary, or in the axils of scales near the base of short lateral leafy branches. *Sepals* and *petals* 9 to 12, imbricate in about 3 series. ♂ *Stamens* 5 to 15 or more, in a spiral series; filaments very short, free or subconnate, often fleshy; anthers free or subimmersed in a fleshy head of confluent filaments, cells small remote. ♀ *Ovaries* many, densely imbricated; stigma sessile; ovules 2 to 4. *Fruit* a globose head of indehiscent, fleshy, 1-seeded carpels. *Seeds* 1 or 2, suspended, albumen fleshy, testa crustaceous; embryo minute.—*Distrib.* Temp. and subtrop. Asia: species about 7.

1. *K. scandens*, Bl. Fl. Jav. *Schizandrea*, p. 9, t. 1. A woody glabrous climber 30 to 40 feet long; the bark dark-coloured, irregularly striate. *Leaves* coriaceous, broadly ovate to ovate-oblong, shortly acuminate, entire, the base rounded very slightly decurrent towards the petiole; main nerves about 5 pairs, sub-erect; length of blade 4 to 6 in., breadth 2 to 4 in.; petiole about 1 in., expanded at the base. *Flowers* axillary, with a few from the trunk below the leaves, solitary, on bracteolate peduncles, those of both sexes similar. *Calyx* of 3 triangular sepals much shorter than the petals and united at the base. *Petals* ovate-oblong, blunt, fleshy, erecto-patent, sub-concave. *Male flowers* with numerous short, cuneate, equal, stamens densely packed on an ovoid, fleshy, receptacle; the connective fleshy, the anthers sub-truncate, 2-celled. *Female flowers* without stamens, the ovaries numerous, compressed; the stigmas sessile, elongate, fleshy. *Ripe fruit* sub-globose, 2 to 2.5 in. in diam.; the individual carpels sessile, globose or subcompressed, fleshy, mucronate or beaked, less than .5 in. in diam. Miq. Fl. Ind. Bat. Vol. I, Pt. ii, 19; *K. cauliflora*, Bl. l. c. p. 11, t. 2; *Sarcocarpum scandens*, Bl. Bijdr. 21.

Perak, Penang; at low elevations. *Distrib* Java, Sumatra, and probably in the other islands of the Archipelago.

2. *K. cauliflora*, Bl. Fl. Jav. *Schizand.* 11, t. 2. A stout woody

climber, 30 to 40 feet long; bark of young shoots dark, smooth; that of the main stem corky, furrowed, lenticellate. *Leaves* ovate-rotund or broadly ovate, slightly and rather abruptly acuminate, the base broad and rounded; nerves 5 to 7 pairs, ascending; length of blade 6 to 7 in., breadth 3·4 to 4·5 in., petiole 1 to 1·5 in. *Flowers* usually from the stem below the leaves, solitary or fascicled, on bracteolate peduncles; rarely axillary. *Sepals* and *petals* as in the last, but larger and more ovate. *Carpels* on pedicels ·5 in. long. Miq. Fl. Fl. Ind. Bat. Vol. I, pt. 2, p. 19.

Perak, Scortechini and King's Collector.

This is very near *K. scandens*, but has corky bark, larger leaves, larger and less orbicular petals, and the flowers are mostly on the old wood and rarely axillary.

3. *K. ROXBURGHIANA*, Arn. in Jard. Mag. Zool. and Bot. II, 546. A glabrous woody and stout climber, with rough bark. *Leaves* membranous, ovate, obovate or oblong, acute or shortly acuminate, entire, the base narrowed; main nerves 7 to 8 pairs, not prominent; length 4 to 6 in., breadth 1·75 to 2·5 in., petiole ·5 in. *Flowers* 5 in. in diam., axillary, solitary, on bracteolate pedicels ·5 in. or more long. *Sepals* and *petals* rotund, concave, fleshy. *Filaments* connate into a column, the upper the smaller. *Ripe fruit* globose, 1 to 2 in. in diam. *Carpels* cuneate with rounded tops. Hook. fil. & Thoms. Fl. Ind. I, 83; Hook. fil. Fl. Br. Ind. I, 45. *Kadsura japonica*, Wall. Tent. Fl. Nep. t. 12. *Uvaria heteroclita*, Roxb. Fl. Ind. ii, 663.

Andamans. Distrib. The base of the Eastern Himalaya and Khasia Hills.

4. *K. LANCEOLATA*, King, n. sp. A slender woody climber, 20 to 30 feet long. *Leaves* thinly coriaceous, lanceolate or ovate-lanceolate, slightly unequal-sided, acuminate, the base cuneate or rounded, edges slightly recurved when dry; nerves obscure, about 12 pairs; length of blade 3 to 4 in., breadth 1·5 in., petiole ·35 in. *Flowers* solitary, axillary, globular, 3·5 in. in diam., on minutely bracteolate peduncles shorter than the petioles. *Sepals* about 3, triangular, much smaller than the petals. *Petals* about 9, rotund or broadly ovate, cream-coloured, fleshy, slightly concave. *Stamens* as in *K. scandens*. *Ripe fruit* globular, ·75 in. in diam. or less. *Pistils* numerous, the stigmas minute, subterminal. *Carpels* ovoid, the apices truncate, the minute, lateral stigmas persistent.

Perak, at elevations of from 500 to 1,000 feet.

A smaller plant than *K. scandens*, with smaller truncate carpels.

ORDER IV. ANONACEÆ. To be taken up subsequently.

## ORDER V. MENISPERMACEÆ.

Climbing or twining, rarely sarmentose, shrubs. *Leaves* alternate, entire or lobed, usually palminerved; stipules 0. *Flowers* small or minute, solitary fascicled cymose or racemed, diœcious, sometimes 3-bracteolate. *Sepals* 6 (rarely 1 to 4, or 9 to 12), usually free, imbricate in 2 to 4 series, outer often minute. *Petals* 6 (rarely 0 or 1 to 5), free or connate. ♂ *Flowers*: *Stamens* hypogynous, usually one opposite each petal, filaments free or connate; anthers free or connate, 2-celled. Rudimentary carpels small or 0. ♀ *Flowers*: *staminodes* 6 or 0. *Ovaries* 3 (rarely 1, or 6 to 12); style terminal, simple or divided; ovules solitary (2 in *Fibraurea*), usually amphitropous. *Ripe carpels* drupaceous, with the style-scar subterminal, or by excentric growth subbasal. *Seed* usually hooked or reniform, often curved round an intrusion of the endocarp (condyle Miers), albumen even or ruminant or 0; cotyledons flat or semiterete, foliaceous or fleshy, appressed or spreading.—A large tropical order; genera 32; species about 100.

Tribe I. *Tinosporeæ*. *Flowers* 3-merous. *Ovaries* usually 3. *Drupe*s with a subterminal rarely ventral or subbasal style-scar. *Seed* oblong or subglobose; albumen copious or scanty; cotyledons foliaceous, usually spreading laterally.

*Drupe*s with a terminal or subterminal style-scar.

Sepals 6; petals 6; filaments free ... 1. *Tinospora*.

Sepals 9; petals 6; filaments free ... 2. *Tinomiscium*.

Sepals 6; petals 0; filaments free ... 3. *Fibraurea*.

*Drupe*s with a subbasal style-scar.

Sepals 6; filaments all connate ... 4. *Anamirta*.

Sepals 9; outer filaments free ... 5. *Oscinium*.

Tribe II. *Cocculæ*. *Flowers* 3-merous. *Ovaries* usually 3. *Drupe* with a subbasal rarely subterminal style-scar. *Seed* horse-shoe shaped, albumen copious; embryo slender, cotyledons linear or slightly dilated.

Sepals 3 to 10, all imbricate; petals 4 to 6, stamens

6 to 10, ovaries 3 to 6, style canaliculate sub-

3-lobed ... 6. *Hyperpa*.

Sepals 9, the inner 3 valvate; petals 3 or 6,

ovaries 3, style compressed ... 7. *Limacia*.

Petals 6; ovaries 3 to 6; styles subulate ... 8. *Cocculus*.

Petals 6; ovaries 3; style forked ... 9. *Pericampylus*.

Tribe III. *Cissampelideæ*. *Flowers* 3 to 5-merous. *Ovaries* usually solitary. *Drupe* with a subbasal style-scar; endocarp dorsally muricate or echinate. *Seed* horse-shoe-shaped; albumen scanty; embryo linear, cotyledons appressed.

Sepals 6 to 10, free; petals of ♂ and ♀ 3-5, free ... 10. *Stephania*.

Sepals 4, free; petals of ♂ 4 connate, of ♀ 1 ... 11. *Cissampelos*.



Sepals 4 to 8, connate; petals of ♂ 4 to 8 connate,  
of ♀ 1, anthers sessile on a central column ... 12. *Cyclea*.

Tribe IV. *Pachygoneæ*. *Flowers* usually 3-merous. *Ovaries* usually 3. *Drupes* with a subbasal or ventral style-scar. *Seed* curved, hooked or inflexed, albumen 0; cotyledons thick fleshy.

Sepals 8; petals 2; stamens 4 or 8 ... 13. *Antitaxis*.

# 1. TINOSPORA, Miers.

Climbing shrubs. *Flowers* in axillary or terminal racemes or panicles. *Sepals* 6, 2-seriate, inner larger membranous. *Petals* 6, smaller. *Male flower*: *stamens* 6, filaments free, the tips thickened: anther cells obliquely adnate, bursting obliquely. *Female flower*: *staminodes* 6, clavate. *Ovaries* 3; stigmas forked. *Drupes* 1-3, dorsally convex, ventrally flat; style-scar subterminal: endocarp rugose, dorsally keeled, ventrally concave. *Seed* grooved ventrally or curved round the intruded sub-2-lobed endocarp; albumen ventrally ruminant; cotyledons foliaceous, ovate, spreading.—Distrib. Species about 8, tropical Asiatic and African.

1. *T. CRISPA*, Miers Contrib. III, 34. Young shoots glabrous, the older bark warted. *Leaves* membranous, glabrous, ovate-cordate or oblong-acuminate, entire or repand, sometimes sub-sagittate; length of blade 2 to 6 in., breadth 1 to 4 in., petiole 1 to 3 in. *Racemes* from the old wood, solitary or fascicled. *Flowers* 2 to 3, in the axils of ovate fleshy bracts, 1.5 in. long, campanulate, green. *Stamens* adnate to the base of the petals, anthers quadrate. *Drupe* elliptic-oblong, pale yellow, about 1.5 in. long or less. Hook. fil. Fl. B. Ind. I, 96; H. f. & T. Fl. Ind. 183; Miq. Fl. Ind. Bat. I, pt. i, 78; Kurz For. Flor. Burmah, I, 52. *Menispermum crispum*, L. *M. verrucosum*, Roxb. Fl. Ind. iii, 808. *M. tuberculatum*, Lamk. *Cocculus crispus*, DC. Prodr. i, 97; Hassk. Pl. Jav. Rar. 166. *Cocculus coriaceus*, Bl. Bijl. 25. *C. verrucosus*, Wall. Cat. 4966 A. B.

In all the provinces, but apparently not very common. Distrib. Malayan Archipelago: tropical British India.

2. *T. ULIGINOSA*, Miers Contrib. iii, 35. All parts glabrous, the branches terete, the lax brown bark bearing many 4-lobed warts. *Leaves* subcoriaceous, remote, ovate or ovate-oblong, acuminate, sub-repand-sinuate or entire, the base cordate 5-nerved; venation prominent; length of blade 3 to 4 in., breadth 1.5 to 2 in.: petiole slender, swollen at the base, 1 to 2 in. long. *Racemes* slender, axillary, longer than the leaves: pedicels 1-flowered. *Drupe* as in *T. crispus*, but with thinner endocarp. Hook. fil. Fl. B. Ind. i, 97. Hook. fil. & Thoms. Fl. Ind. 105. *Cocculus petiolaris*, Wall. Cat.

Malacca, Maingay. Distrib. Java and Borneo.

A species of which I have seen no good specimen. The foregoing description is chiefly copied from Miers.

#### 4. TINOMISCUM, Miers.

A scandent shrub, juice milky. *Flowers* racemed. *Sepals* 9, with 3 bracts. *Petals* 6, oblong, margins incurved. *Male flower*: *stamens* 6, filaments flattened; anthers oblong, adnate, bursting vertically. *Rudimentary carpels* 3. *Female flower* unknown. *Drupe* much compressed, ovoid-oblong, style-scar terminal; endocarp much compressed, dorsally convex, ventrally flat or slightly concave, not intruded. *Seed* almost flat, oblong; cotyledons quite flat, nearly as broad as the thin layer of albumen, very thin, closely appressed; radicle short cylindric.—Distrib. 3 E. Asiatic species.

T. PETIOLARE, Miers Contrib. iii, 45, t. 94. Young shoots and rachises of inflorescence brown-tomentose: bark of older branches nearly glabrous, pale brown, deeply striate, very sparsely verrucose. *Leaves* membranous, glabrous, ovate-oblong, obtuse or shortly and suddenly acuminate, entire, the base rounded or truncate, 5-nerved, the nerves all sparsely pubescent and 2 of them small; length of blade 4 to 8 in., breadth 2 to 4.5 in.; petiole 2 to 5 in., slender. *Racemes* fasciculate on stem tubercles, 4 to 8 in. or even 12 in., long. *Flowers* .35 in. in diam.; sepals puberulous. *Drupe* elongate-ovoid, compressed, 1.25 in. long, and .75 in. broad; endocarp rugose, woody. Miq. Fl. Ind. Bat. i. pt. i, 87; Hook. f. Fl. B. Ind. i. 97.

Common in the Straits Settlements. Distrib. Sumatra.

#### ANAMIRTA, Miers.

Climbing shrubs. *Flowers* in panicles. *Sepals* 6, with 2 appressed bracts. *Petals* 0. *Male flower*: *anthers* sessile, on a stout column, 2-celled, bursting transversely. *Female flower*: *staminodes* 9, clavate, 1-seriate. *Ovaries* 3, on a short gynophore: stigma sub-capitate, reflexed. *Drupe* on a 3-fid gynophore, obliquely ovoid, dorsally gibbous, style-scar sub-basal; endocarp woody. *Seed* globose, embracing the sub-globose hollow intruded endocarp; albumen dense, of horny granules: embryo curved; cotyledons narrow, oblong, thin, spreading.

1. A. LOUREIRI, Pierre Flore Forest. Coch. Chine, t. 110. Glabrous; bark of the younger branches brown, that of the older pale and slightly striate. *Leaves* sub-coriaceous, shining, ovate-rotund to broadly elliptic, abruptly and shortly acuminate, entire, the base sometimes minutely cordate 5-nerved and with 4 small pits between the nerves at

their junction with the petioles; length of blade 4 to 5 in., breadth 3·5 to 4 in.; petiole 3 to 3·5 in. slender, swollen and bent at the base. *Racemes* extra-axillary, slender, branched, 3 to 6 in. long. *Male flowers* sessile, 1 in. in diam., anthers 9. *Female flower* unknown; ripe inflorescence stout, woody, a foot or more long: pedicel of ripe fruit much thickened, clavate, rugose; ripe *drupe* transversely ovoid, sub-compressed, 1·25 long by nearly 1·5 broad; pericarp, thick, fibrous, pulpy; endocarp woody, rugose.

Malacca, Maingay No. 116, 115 (in part). Perak, common. Distrib. Cochin-China.

An enormous climber, often with a stem 4 in. in diameter. The leaves and male flowers are excellently figured by M. Pierre, who however does not appear to have seen the ripe fruit.

#### FIBRAUREA, Loureiro.

Glabrous climbing shrubs. *Leaves* ovate to oblong, 3-nerved. *Flowers* in panicles, *Sepals* 6, with 3 minute bracts, inner larger. *Petals* 0. *Male flower*: *stamens* 6, filaments clavate: anthers terminal, adnate; cells spreading, bursting vertically. *Female flower*: *staminodes* 6. *Ovaries* 3, ovoid, 2-ovuled; stigma sessile, punctiform. *Drupe*s 1-seeded, oblong, terete, style-scar subterminal; endocarp oblong, dorsally convex, ventrally flattened and channelled, hardly intruded. *Seed* oblong, terete, reniform on a transverse section; albumen copious, horny; cotyledons foliaceous, longitudinally curved, oblong, very thin; radicle short, cylindric.

1. *F. CHLOROLEUCA*, Miers Contrib. iii, 42. Glabrous, the branches striate; bark of the young branches brown, of the old pale. *Leaves* coriaceous, ovate-oblong, shortly acuminate; the base rounded, 5-nerved (2 of the nerves joining the central one half an inch above the base); venation inconspicuous; length of blade 5 to 9 in., breadth 2·5 to 4 in.; petiole 2 to 4 in., rather slender but swollen and curved towards the base. *Panicles* extra-axillary, or from the stem below the leaves, slender, lax, their branches horizontal, 3 to 8 in. long. *Male flowers* 2 in. in diam., shortly pedicellate; filaments clavate, flattened. *Female flower* unknown; the ripe female inflorescence slender, stouter than the leaf-petioles, about 1 foot long. *Ripe drupes* on rather slender terete pedicels which are capitate at the apex and ·5 in. long, ovoid, smooth, pulpy, rather more than 1 in. long, ·75 in. in diam., endocarp smooth.

Malacca, Perak; not uncommon. Distrib. Sumatra, Borneo.

This appears to me to be a different plant from Loureiro's *F. tinctoria*, the type of which is in the British Museum.

## 7. COSCINIUM, Colebrooke.

Climbing shrubs. *Flowers* in dense globose heads. *Sepals* 6, with a bract, orbicular. *Petals* 3, large, spreading, elliptic. *Male flower*: *stamens* 6, filaments cylindric, 3 inner connate to the middle; anthers adnate, outer 1- inner 2-celled, bursting vertically. *Fem. flower*: *staminodes* 6. *Ovaries* 3-6, subglobose; styles subulate, reflexed. *Drupe*s globose; endocarp bony. *Seed* globose, embracing a globose intrusion of the endocarp; albumen fleshy, ruminant in the ventral face; embryo straight, cotyledons orbicular, spreading, thin, sinuate, lacinate, or fenestrate.—Distrib. Species 2; tropical Asiatic.

1. *O. FENESTRATUM*, Colebrooke in Trans. Linn. Soc. xiii, 65. Young shoots faintly striate, shortly tomentose, often ferruginous. *Leaves* coriaceous, very slightly peltate, rotund-ovate, acute or shortly acuminate, the base truncate and sometimes sub-sinuate, shining above, yellow-tomentose beneath, except the 7 stout glabrous nerves; reticulations prominent; length of blade 5 to 7 in., breadth 4 to 6 in.; petiole 2 to 3 in., swollen and bent at base. *Flowers* in small pedunculate heads, in extra-axillary racemes shorter than the leaves. *Petals* orbicular and, like the sepals, persistent. *Ripe drupes* on stout pedicels with capitate apices, globose, tomentose, .75 in. in diam.; cotyledons lacinate. Miers in Hook. Bot. Mag. t. 6458; Contrib. iii. 22, t. 38; H. f. & T. Fl. Ind. 178. Hook. fil. Fl. Brit. Ind. i. 99. *O. Maingayi*, Pierre Fl. Coch. Chine. *O. Wallichianum* and *Wightianum*, Miers in Tayl. Ann. Ser. 2, vii. 37, Contrib. iii. 23. *Menisp. fenestratum*, Gærtn.; DC. Prod. i. 103; Roxb. Fl. Ind. iii. 809. *Cocculus Blumeanns*, Wall. Cat. 4971, partly: *Percira medica*, Lindl. Fl. Med. 307.

Straits Settlements, at low elevations, not so common as the next. Distrib. Ceylon, and perhaps some of the Malayan Islands.

The Ceylon specimens have larger leaves and a more condensed inflorescence than the Malayan; but the flowers are alike. Pierre's species *O. Maingayi* is founded on Maingay's Malacca specimens (Kew. Distrib. 117) but I cannot see that they differ specifically from his No. 118, or from Wallich's.

2. *C. BLUMEANUM*, Miers Contrib. iii, 23. Young shoots sub-striate, tawny-tomentose. *Leaves* coriaceous, peltate, oblong, elliptic, rarely ovate-rotund, obtuse or acute, the base rounded or truncate, sometimes sub-sinuate, shining above, white-tomentose beneath, the 7 nerves bold and prominent on lower surface as are the reticulations, length of blade 8 to 12 in., breadth 4 to 7 in.; petiole 4 to 6 in., swollen at base and apex. *Male inflorescence*, 5 in. long, racemose, densely ferruginous-tomentose; the flower heads .35 in. in diam. *Female inflorescence* from the stem, 8 in. long, its branches horizontal: drupes globular, tomen-

toso. Hook. fil. & Thoms Fl. Ind. 179; Hook. fil. Fl. B. Ind. i. 99; Miq. Fl. Ind. Bat. i. Pt. 1, 77: *Cocculus Blumeanus*, Wall. Cat. 5971 partly.

Climbing like the last on high trees. I have not seen specimens of the ripe drupe.

#### LIMACIA, Loureiro.

Climbing shrubs or small trees: flowers in racemes or panicles. *Sepals* 9, tomentose, in three series; the two outer smaller, ovate; the inner large, rotund, concave, valvate. *Petals* 3 or 6, small, (as large as the outer 3 sepals), obovate, clawed, glabrous, embracing the stamens. *Stamens* 3 or 6, free, sub-equal; filaments short, erect, thickened upwards; anthers connivent, cordate, 2-lobed. *Fem. flower*; *sepals* and *petals* as in male; *staminodes* 6, clavate. *Ovaries* 3, hirsute. *Style* short. *Drupe*s 3, usually 1 by abortion, obovoid or reniform, fleshy; style-scar subbasal; endocarp 3-celled, the 2 lateral cells empty. *Seed* elongate, embracing the intruded endocarp; embryo slender, the cotyledons linear, plano-convex. Distrib. Tropical Asia.

1. *L. TRIANDRA*, Miers Contrib. iii, 112. Branches closely striate, puberulous when young, glabrous when adult. *Leaves* membranous, ovate-lanceolate, acuminate, 3-nerved above the rounded base, length of blade 3 to 5 in., breadth 1·5 to 2 in., petiole about ·5 in. *Racemes* supra-axillary, shorter than the leaves, usually solitary, puberulous; bracts and flowers minute. *Stamens* 3, free, the filaments cuneate; anthers large, the cells divergent. Hook. fil. Fl. B. Ind. i. 100; Miq. Fl. Ind. Bat. i. pt. 1, 80. Kurz For. Flor. Burm. i, 55; H. f. & T. Fl. Ind. 188. *L. Amherstiana* and *Wallichiana*, Miers l.c. 112, 113. *Menisp. triandrum*, Roxb. Fl. Ind. iii. 816. *Cocculus triandrus*, Colebrooke in Trans. Linn. Soc. xii. 64; Wall. Cat. 4962, 4959 C. 4958 L.

Penang. Distrib. Burmah.

2. *L. OBLONGA*, Miers Contrib. iii. 109. Scandent or shrubby; branches minutely striate, rusty-puberulous when young. *Leaves* membranous, glabrous, oblong-lanceolate or broadly elliptic, acute or mucronate; the base rounded, 3-nerved; reticulations few, bold, pubescent like the nerves and petiole; length of blade 4 to 7 in., breadth 2·25 to 3·5 in., petiole ·75 to 1·25 in. *Male panicles* slender, extra-axillary, usually in pairs, much longer than the leaves, branched, rusty-pubescent. *Stamens* 6, filaments thickened upwards but not cuneate. *Female inflorescence* much shorter. *Drupe* transversely reniform, compressed, glabrous, pulpy, rugose when dry, ·75 in. long, styler scar on a sub-basal projecting horn. Hook. fil. & Th. Fl. Ind. 189; Hook. fil. Fl. B. Ind. i. 100; Miq. Fl. Ind. Bat. i. Pt. i, 80. *Cocculus oblongus*, Wall. Cat.

Common in all the Straits Settlements.

Miers remarks that Wallich describes the species as a bush. Mr. Kunstler, who collected it at various places in Perak, describes one set of his specimens (No. 6184) as bushes of 8 to 10 feet: the other he describes as climbers. Between the male flowers of these two I can detect no difference. The species is at once recognised by the length of the panicles of male flowers.

3. *L. VELUTINA*, Miers Contrib. iii. 110. Whole plant, but especially the young branches, olivaceous-tomentose. Leaves thinly coriaceous, ovate-oblong, often slightly obovate, obtuse, acute or shortly and finely acuminate, the base acute or rounded; when adult glabrous and shining above except the midrib; beneath olivaceous-pubescent; 3-nerved; length of blade 3·5 to 5·5 in., breadth 1·5 to 2·25 in.; petiole 5 to ·75 in., stout, terete. Cymes shorter than the petiole, umbellate, in axillary fascicles of 2 to 6. Male flowers small. Stamens 6, filaments much thickened upwards; anthers large, 2-celled. Drupes 1 or 2, transversely reniform, very little compressed, sparsely tomentose; otherwise as in the last. Hook. fil. Fl. Br. Ind. I. 100; Miq. Fl. Ind. Bat. i. Pt. i, 80; Kurz For. Flor. Burmah I, 55; H. f. & T. Fl. Ind. 189. *L. inornata*, Miers l. c. iii. t. 109. *Cocculus velutinus*, Wall. Cat. 4970.

Var. *GLABRESCENS*, leaves nearly glabrous. *L. distincta*, Miers Contrib. iii, 111, t. 109.

In Forests in the Straits Settlements. Distrib. Sumatra.

A slender climber 15 to 20 feet long: readily recognised by the yellowish olivaceous tomentum, and short cymose inflorescence.

4. *L. KUNSTLERI*, King, nov. spec. Branches, petioles, and nerves of leaves softly pubescent. Leaves sub-coriaceous, glabrous, pale beneath, shortly petiolate, lanceolate, mucronate, the base cuneate, 3-nerved; reticulations wide, distinct; length of blade 1·5 to 2·5 in., breadth ·5 to 1 in., petiole 2 in. Cymes pedunculate, axillary, solitary, little longer than the petioles; or in terminal racemes. Male flowers small. Stamens 6, the filaments short, clavate; anthers large, cordate, 2-celled, connivent.

North Coast of Singapore near the Sea; King's Collector, No. 70.

This very distinct species has been gathered only once. Only the male flowers are known, but they are unmistakably those of a *Limacia*. The species is distinguished by its shortly petiolate small leaves, and numerous short cymes which (toward the end of the branches) are arranged in racemes.

#### *HYPSPERPA*, Miers.

Climbing shrubs. Flowers in short axillary cymes. Parts of flower varying in number. Sepals in three rows, the outer 3 bractiform

and hairy : the inner 6 to 8 much larger ; all imbricate, glabrous. *Petals* 4 to 6, smaller than the inner sepals, oblong, incurved at the apex, rather fleshy. *Stamens* 6 to 10, free, in two series ; filaments compressed, thickened upwards : anthers ovate, 2-celled. *Female flower* (*vide* Miers) *Sepals* 8, oblong, all imbricate. *Petals* 5 or 6, oblong, concave. *Staminodes* 6, clavate. *Ovaries* 6, rarely 3. Style very short. *Drupe*s 2-3, transversely ovate, fleshy ; endocarp bony, sub-globose, slightly compressed, with radiating grooves, and with a single lunate cell : embryo terete, slender ; radicle as long as the cotyledons.

1. *H. TRIFLORA*, Miers Contrib. iii, 102. Branches striate, the youngest pubescent. *Leaves* small, sub-coriaceous, shining, glabrous, oblong-lanceolate, tapering gradually to the rather blunt minutely mucronate apex ; the base rounded, 3-nerved ; reticulations fine, but rather obscure, as are the nerves ; length of blade 1·5 to 3·5 in., breadth ·5 to 1·25 in., petiole ·3 to ·5 in. *Cymes* about 3-flowered, little longer than the petioles, usually solitary, axillary and supra-axillary, the female shorter.

Malacca ; Griffith, Maingay (Kew Distrib., 123) : Perak ; Scortechini, King's Collector. Distrib. Sumatra.

The Perak specimens agree with the types of Miquel's *Limacia microphylla* from Sumatra in Herb. Calcutta ; and they do not agree in externals with the Indian *L. cuspidata*. Ripe fruit of this is unknown. But the flowers are so different from those of *Limacia* that I think it ought not to be included in that genus, and I further venture to think that Miers's genus *Hypserpa* has a sufficiently sure basis on the structure of the flowers alone.

## 10. COCCULUS, DC.

Climbing or sarmentose shrubs, rarely suberect. *Petiole* not dilated at the base. *Flowers* in panicles. *Sepals* 6, 2-seriate, outer smaller. *Petals* 6, smaller, usually auricled. *Male flower* : *stamens* embraced by the petals ; anthers sub-globose, cells bursting transversely. *Female flower* : *staminodes* 6 or 0. *Ovaries* 3 to 6 : styles usually cylindric. *Drupe*s laterally compressed ; endocarp horse-shoe-shaped, dorsally keeled and tubercled, sides excavate. *Seed* curved, albumen fleshy ; embryo annular ; cotyledons linear, flat, appressed.—Distrib. All warm climates.

1. *C. KUNSTLERI*, King, n. sp. Glabrous ; the branches striate, pale. *Leaves* membranous, with long petioles, peltate, rotund, acute ; nerves 9, radiating from the petiolar insertion, thin but prominent on the pale under surface ; length of blade 3·25 to 4 in., breadth about ·25 in. or less ; petiole slender, terete, about 3 in. long. *Panicles* in fascicles of 2 to 4 from flat warty tubercles on the stem, narrow, the lateral branches only about ·5 in. long, few-flowered. *Sepals* imbricate, glabrous. *Petals* 6,

each embracing a stamen. *Filaments* free, clavate; anthers broad, 4-celled. *Ripe drupes* 1 to 1.25 in. long, and about 6 in. broad, narrowly sub-obovoid, compressed; pericarp of a thin pulp; endocarp horny, narrowly horse-shoe-shaped, the edge boldly ridged, the sides with deep radiating grooves and the central part with a deep vertical hollow: embryo sausage-shaped, bent along the circumferential chamber of the endocarp.

Perak, Ulu Bubong; King's collector, Nos. 4417 and 10282.

This has the flower of *Cocculus*, but the fruit of *Stephania*. It comes nearest to the Indian *C. macrocarpus*, which has a similar though smaller fruit, and, like that species, would belong to Miers' genus *Diploclisia*. It must be near *D. pictinervis* of that author.

#### 11. PERICAMPYLUS, Miers.

A climbing shrub. *Leaves* subpeltate; petioles slender, articulate. *Flowers* in axillary cymes. *Sepals* 6, with 3 bracts, outer smaller, inner spatulate. *Petals* 6, cuneate. *Male flower*: *stamens* 6, filaments cylindrical; anthers adnate, bursting transversely. *Female flower*: *staminodes* 6, clavate. *Ovaries* 3; styles 2-partite, segments subulate. *Drupe* subglobose; endocarp horse-shoe-shaped, dorsally crested and echinate, sides excavated. *Seed* curved; cotyledons elongate, flat, scarcely broader than the radicle.

1. *P. INCANUS*, Miers Contrib. iii. 118, t. 3. Young branches minutely tomentose, not striate. *Leaves* membranous, orbicular-reniform, obtuse or acute, sometimes slightly retuse, mucronulate, the base truncate or sub-cordate; upper surface pubescent or glabrescent, lower tomentose; nerves usually 5; length of blade 2 to 4 in., breadth about .5 in. or more; petiole 1 to 2 in. *Cymes* pedunculate, axillary, in fascicles of about 4, 2-3-chotomous. *Flowers* minute, crowded. *Petals* 6, obovate, larger than the sepals. *Ripe drupe* the size of a pea. Hook. fil. Fl. Br. Ind. i. 102; Hf. & Th. Fl. Indica, 194; Miq. Fl. Ind. Bat. i. Pt. 1, 83. *P. aduncus*, *assamicus*, and *membranaceus*, Miers l. c. 119-122. *Cocculus incanus*, Coleb. in Trans. Linn. Soc. xiii. 57. *Oissampelos mauritiana*, Wall. Cat. 4980 (not of DC.). *Menisp. villosum*, Roxb. Fl. Ind. iii, 812 (not of Lamk.).

A common climber. Distrib. British India, Java, Sumatra, and probably in other parts of the Malayan Archipelago.

#### 12. STEPHANIA, Loureiro.

Climbing shrubs. *Leaves* usually peltate. *Flowers* in axillary, cymose umbels. *Male flower*: *sepals* 6 to 10, free, ovate or obovate. *Petals* 3 to 5, obovate, fleshy. *Anthers* 6, connate, encircling the top of the



staminal column, bursting transversely. *Female flower*: sepals 3 to 5. *Petals* of the male. *Staminodes* 0. *Ovary* 1; style 3 to 6-partite. *Drupe* glabrous; endocarp compressed, horse-shoe-shaped, dorsally tubercled, sides hollowed and perforated. *Seed* almost annular; cotyledons long, slender,  $\frac{1}{2}$ -terete, appressed.—Distrib. Tropics of the Old World.

1. *S. HERNANDIFOLIA*, Walp. Rep. i, 96. Young branches striate, glabrous. *Leaves* membranous, broadly ovate-rotund, acute or acuminate, rarely obtuse, peltate; the base truncate, emarginate or sub-cordate; glabrous or sparsely pubescent; nerves about 10 radiating from the petiolar insertion, dark-coloured on the pale or glaucous under surface, reticulations open; length of blade 2·5 to 5 in., breadth 2·25 to 3 in. petiole 1·75 to 2 in. *Umbels* on long slender peduncles, many-flowered. *Petals* 3 to 4. *Drupe*s red, pisiform, compressed. Hook. fil. Fl. Br. Ind. i, 103; Hf. & T. Fl. Ind. 196; Miq. Fl. Ind. Bat. i, Pt. 1, 83. Miers Contrib. iii. 222. *S. intertexta*, *latifolia*, and *hypoglauca*, Miers l. c. 224, 226, 227. *Cissampelos hernandifolia*, Willd.; DC. Prodr. i. 100; Roxb. Fl. Ind. iii. 842; Wall. Cat. 4977 D, E, F, G, H, K. *C. discolor*, DC. l.c. i. 101; Bl. Bijdr. 26. *C. hexandra*, Roxb. l.c. iii. 842. *Olypea hernandifolia*, W. & A. Prodr. i. 14; Wight Ic. t. 939. *Steph. discolor*, Hassk. Pl. Jav. rar. 168.

Common in shady places. Distrib. The Malayan British India, Australia, Africa.

### 13. *CISSAMPELOS*, Linn.

Suberect or climbing shrubs. *Leaves* often peltate. *Male flowers* cymose. *Sepals* 4, 5 or 6, erose. *Petals* 4, connate, forming a 4-lobed cup. *Anthers* 4, connate, encircling the top of the staminal column, bursting transversely. *Female flower*: racemed, crowded in the axils of leafy bracts. *Sepals* 2 (or sepal and petal 1 each), 2-nerved, adnate to the bracts. *Staminodes* 0. *Ovary* 1; style short, 3-fid or 3-toothed. *Drupe* ovoid, style-scar sub-basal; endocarp horse-shoe-shaped, compressed, dorsally tubercled, sides excavated. *Seed* curved; embryo slender; cotyledons narrow,  $\frac{1}{2}$ -terete, appressed.—Distrib. All hot climates,

1. *C. PAREIRA*, Linn. Young branches pubescent. *Leaves* usually peltate, membranous, orbicular-reniform or cordate, obtuse and mucronate, rarely acute, base truncate to cordate, above glabrescent, below pubescent to tomentose; length 1·8 to 3 in., breadth rather greater, petiole 1 to 3 in. *Male cymes* 2 or 3, axillary, slender. *Female racemes* with large reniform or orbicular bracts. *Ripe drupes* scarlet, sub-globose, hirsute, 2 in. in diam., Hook. fil. Fl. Br. Ind. i. 104; H. f. & Th. Fl. Indica 198; Miq. Fl. Ind. Bat. i. Pt. 1. 85; DC. Prodr. i. 100; Miers' Contrib. iii. 139: *C. caapeba*, Linn. Roxb. Fl. Ind. iii. 842. *C. convo-*

*Isnlacea*, Willd. Wall. Cat. 4979; W. & A. Prod. i. 14; Roxb. l. c. *O. orbiculata*, *discolor* and *hirsuta*, Ham. DC. l. c. 101. *O. diversa*, *gral-latoria*, *eriantha*, *elata* and *delicatula*, Miers l. c. 187-189. *O. sub-peltata*, Thw. Enum. 13 & 399; Miers l. c. 195. *Menispermum orbiculatum*, Linn.

A common climber in all parts of the Settlements. Distrib. Everywhere in the Tropics.

#### 14. CYCLEA, Arnott.

Climbing shrubs. *Leaves* usually peltate. *Flowers* in axillary panicles; *Male flower*: *sepals* 4-8, connate into an inflated 4-5-lobed calyx. *Petals* 4 to 8, more or less connate into a 4 or 8-lobed corolla. *Anthers* 4 to 6, connate, crowning the staminal column, bursting transversely. *Female flower*: *sepal* 1, oblong. *Petal* 1, orbicular. *Ovary* 1; style short, 3 to 5-lobed, lobes radiating. *Drupe* ovoid, style-scar subbasal; *endocarp* horse-shoe-shaped, dorsally tubercled, sides convex, 2-locellate (as in *Limacia*). *Seed* curved; cotyledons slender,  $\frac{1}{2}$ -terete, appressed.—Distrib. Tropical Asia.

1. *C. PELTATA*, H f. & Th. Fl. Indica, 201. Branchlets striate, reflexed, pubescent or glabrous. *Leaves* coriaceous, peltate, deltoid or orbicular-ovate, acute or acuminate, often mucronate, the base truncate to cordate; above glabrous or glabrescent, beneath pubescent to tomentose, the 9 nerves rather prominent, length of blade 4.5 to 5.5 in., breadth 3.5 to 4.5 in.; petiole .2 to 2.5 in., reflexed, pubescent or tomentose, striate. *Panicles* usually longer than the leaves, the males often much branched and spreading and a foot long, the females smaller. *Calyx* campanulate, 4-lobed, glabrous or pilose externally. *Corolla* much smaller. *Drupe* pisiform, pilose; *endocarp* much tuberculate. Hook. fil. Fl. Br. Ind. i. 104; Miq. Fl. Ind. Bat. i. Pt. 1, 86; Miers Contrib. iii. 236; *C. barbata*, *Arnottii*, *versicolor*, *laxiflora* and *pendulina*, Miers l. c. *Menisp. peltatum*, Lamk. *Cocculus peltatus*, DC. Prod. i. 96. *Olypea Burmanni*, W. & A., in part. *Cyclea Burmanni*, Arnot in Wight Ill. i. 22. *Rhaptomeris Burmanni*, Miers in Tayl. Ann. Ser. 2, vii. 41.

Not common in the Straits Settlements. Distrib. Java, British India, Ceylon.

2. *C. ELEGANS*, King, nov. spec. Young branches spirally striate, puberulous, as are the petioles and panicles; otherwise glabrous. *Leaves* slightly peltate, membranous, shining on both surfaces, the reticulations minute, distinct, ovate to ovate-oblong, shortly acuminate, the base rounded or cordate, 7-nerved (4 of the nerves minute); length of blade 3 to 4 in., breadth 1.5 to 2 in., petiole about 1 in. *Males* and *females*

*panicles* sub-equal, slender, solitary, axillary, shorter than the leaves. *Male flowers* crowded, minute; anthers about 4, broad. *Drupe* pisiform, slightly compressed, pulp thin, endocarp boldly tubercled.

Perak; at elevations of from 1500 to 2000 feet; King's collector, Scortechini. A slender creeper 15 to 25 feet long; not common.

#### ANTITAXIS, Miers.

Climbers or shrubs with penninerved leaves. *Pedicels* 1-flowered, numerous, in axillary fascicles, flowers dioecious. *Male flower*: *sepals* eight, in decussate pairs, the two outer pairs oblong, pubescent; the two inner pairs rotund, concave, glabrous, imbricate, all increasing in size inwards. *Petals* 2, smaller than fourth row of sepals, rotund, concave. *Stamens* 4 or 8, filaments clavate, anthers sub-globose. *Female flower* unknown. *Drupe* 1-3 (usually 1) sub-globose, or pyriform: endocarp brittle, thin, sub-reniform, 1-celled. *Seed* sub-globular, concave ventrally, albumen none; cotyledons oblong, semi-terete, thick, incurved; radicle minute.—Distrib. Eastern Archipelago.

1. *A. LUCIDA*, Miers Contrib. iii. 357. A glabrous climber, bark of young shoots dark and smooth, that of old shoots pale and warted. *Leaves* coriaceous, shining, oblong or sub-obovate-oblong, acute or acuminate, the base slightly narrowed, nerves about 6 pairs, obscure, as are the reticulations; length of blade 3 to 3·5 in., breadth 1·25 to 1·5 in., petiole ·5 in. *Female flowers* (male unknown) in fascicles. *Drupe* 1 to 3, (usually solitary) pyriform, glabrous, shining, about ·5 in. long, pericarp pulpy; endocarp thin, brittle.

On Ulu Bubong in Perak, King's collector. Distrib. Java.

A slender creeper from 40 to 60 feet long. *Male flowers* of this are unknown, and I put it into this genus on account of the structure of the fruit and from its general resemblance to *A. fasciculata*, Miers, which however differs in being non-scandent and in having tomentose drupes. Kurz's species *A. calocarpa* has 8 stamens (although he describes it as having only 4), and is also a climber with glabrous drupes. I have modified Miers' description of the genus as to the number of stamens and other particulars.

#### ORDER VI. NYMPHÆACEÆ.

Aquatic perennial herbs. *Leaves* usually floating, often peltate, margins involute in veneration. *Scapes* 1-flowered, naked. *Floral-whorls* all free, hypogynous or adnate to a fleshy disk that surrounds or envelops the carpels. *Sepals* 3 to 5. *Petals* 3 to 5, or many. *Stamens* many. *Carpels* 3 or more in one whorl, free or connate, or irregularly sunk in pits of the disk; stigmas as many as carpels, peltate or decurrent; ovules few,

or many and scattered over the walls of the cells, anatropous or orthotropous. *Fruit* formed of the connate carpels, or of separate and indehiscent carpels, or of the enlarged turbinate flat-topped disk with the nut-like carpels sunk in its crown. *Seeds* naked or arilled; albumen floury or 0; embryo enclosed in the enlarged amniotic sac.—Distrib. Temperate and tropical; genera 8, species 30-40.

Suborder I. *Nymphææ*. *Sepals* 4-6. *Petals* and *stamens* indefinite. *Carpels* confluent with one another or with the disk into one ovary. *Ovules* many. *Seeds* albuminous.

*Sepals*, petals and stamens  $\frac{1}{2}$ -superior, inserted on the disk which is confluent with the carpels ... 1. *Nymphæa*.

*Sepals* inferior; petals superior; carpels sunk in the torus ... 2. *Barclaya*.

Suborder II. *Nelumbicæ*. *Sepals* 4-5. *Petals* and *stamens* indefinite. *Carpels* irregularly scattered, sunk in pits of the turbinate disk. *Ovules* 1-2. *Seeds* exalbuminous... 3. *Nelumbium*.

### 1. NYPHÆA, L.

Large herbs; rootstock creeping. *Flowers* expanded, large, floating on long radical scapes. *Sepals* 4, adnate to the base of the disk. *Petals* in many series, inner successively transformed into stamens, all adnate to the disk. *Filaments* petaloid; anthers small, linear, introrse. *Ovaries* many, 1-seriate, sunk in the fleshy disk and forming with it a many-celled syncarp crowned by connate, radiating, stigmas: ovules many, anatropous. *Fruit* a spongy berry ripening under water. *Seeds* small, buried in pulp.—Distrib. Species 20, most temperate and tropical regions.

1. *N. stellata*, Willd. *Leaves* elliptic, deeply cordate, entire or with obtuse shallow sinuate teeth, often blotched with purple below, 6 to 8 in. long. *Flowers* 1.5 to 9 in. in diam., blue (white, or pink in varieties), petals 10 to 30, linear-lanceolate. *Stamens* 10 to 50, anthers with apical appendages. *Stigmatic rays* 10 to 25. *Fruit* 1.5 to 2 in. in diam. *Seeds* sub-striate. Hook. fil. Fl. B. Ind. i. 114: Hook. fil. & Th. Fl. Ind. i. 243: Wight Ic.  $\frac{1}{4}$  & 5: Miq. Fl. Ind. Bat. i. Pt. ii. 90.

Common throughout the warmer parts of the Indo-Malayan region. Distrib. Australia.

Var. 1. *versicolor*, Hf. & Th. l. c. *Flower* and *leaves* intermediate between this and the next; the former white, rose or blue. *N. versicolor*, Roxb. Hort. Beng. 41; Fl. Ind. ii. 577; Bot. Mag. t. 1189; Wall. Cat. 7257. *N. punctata*, Edgew. in Trans. Linn. Soc. xx. 29. *N. Edgeworthii* and *N. Hookeriana*, Lehm. der Gatt. Nymph. 7 and 21.

Var. 2. *parviflora*. Hf. & Th. l. c. *Leaves* and *flowers* much

smaller than in the last, the latter usually blue and sometimes not more than 1 to 2 in. in diam. *N. stellata*, Willd. W. & A. Prod. i. 17.

## 2. BAROLAYA, Wallich.

Aquatic herbs with short villous root-stocks and floating leaves. *Peduncles* elongate, sometimes extra-axillary. *Flowers* pink or claret-coloured. *Sepals* 5, inserted at the base of the ovary. *Petals* numerous, 3-seriate, united below into a tube which is confluent with the carpels. *Stamens* in many series inserted within the corolla tube, filaments slender, short, reflexed; the anthers pendulous, the outer imperfect. *Ovaries* about 6 to 8, confluent, the apex conical; styles tri-angular, connivent into a 10-rayed cone, stigmatiferous within: ovules numerous, orthotropous, parietal. *Berry* globose, pulpy, crowned with the corolla-tube and annular torus. *Seeds* elliptic, albumen floury, embryo small.

1. *B. MOTTLEYI*, Hook. fil. in Trans. Linn. Soc. xxiii. 157, t. 21. *Leaves* rotund, the apex sometimes bluntly apiculate, the base deeply cordate, glabrous on the upper surface, otherwise tomentose as are the peduncles; length 3 in., breadth 3.5 in., petiole 3 to 7 in. *Sepals* tomentose externally with long glabrous sub-apical tails. *Petals* linear, pink or red. *Seeds* echinate.

In ponds at low elevations in the Forest. Malacca, Griffith; Maingay, Perak, Scortechini, Wray, King's collector. Distrib. Borneo, Motley, Lobb.

Var. *KUNSTLERI*, King. *Leaves* ovate-rotund, cordate, the under surfaces and petioles pubescent or glabrous, as are the peduncles: *petals* claret-coloured; *seeds* rugose, occasionally echinate.

In similar situations with the last. Perak; King's collector, Scortechini, Wray. The leaves of this are thinner in texture than those of the typical form.

2. *B. LONGIFOLIA*, Wall. in Trans. Linn. Soc. xv. 442, t. 18. *Leaves* oblong, obtuse, the base cordate, glabrous or glabrescent, length 6 to 8 in., breadth 1 to 1.5 in., petiole 4 to 8 in. *Sepals* glabrous or glabrescent with short apical tails. *Petals* oblong, reddish within, green externally. *Seeds* echinate, Hook. fil. Fl. B. Ind. i. 115; Hook. Ic. Pl. t. 809, 810; Griff. Notul. 218, t. 57; H. f. & T. Fl. Ind. 246.

Andamans. Distrib. Burmah.

## 3. NELUMBium, Juss.

An erect large water herb with milky juice; rootstock stout, creeping. *Leaves* raised high above the water, peltate. *Flowers* rose-red white or yellow. *Sepals* 4-5, inserted on the top of the scape, caducous, *Petals* and *stamens* many, hypogynous, many-seriate, caducous. *Anthers*

with a clubbed appendage. Ovaries many, 1-celled, sunk in the flat top of an obconic fleshy torus, attachment lateral; style very short, exserted, stigma terminal, dilated; ovules 1-2, pendulous. Carpels ovoid, loose in the cavities of the enlarged spongy torus; pericarp bony, smooth. Seed filling the carpel, testa spongy, albumen 0; cotyledons fleshy, thick, enclosing the large folded plumule.—Distrib. Species 2, one Asiatic and Australian; the other W. Indian.

1. *N. SPECIOSUM*, Willd. Leaves 2 to 3 feet in diam., concave, glaucous. Peduncles and petioles 3 to 6 feet long, smooth, or with small scattered prickles. Flowers 4 to 10 in. diam.; petals elliptic, rose, rarely white. Fruiting torus flat-topped 2 to 4 in. diam. Ripe carpels ovoid, about 5 in. long. Wight & Arn. Prodr. i. 16; Roxb. Fl. Ind. II. 647; Wight III. i. t. 9; H. f. & T. Fl. Ind. 247; Miq. Fl. Ind. Bat. i. Pl. 2, p. 91. *N. asiaticum*, Rich. in Ann. Mus. xvii. 249, t. 9. *Nelumbo Indica*, Poir. Encycl. iv. 453. *Nelumbo*, Smith Exot. Bot. i. 59, t. 31, 32. *C. mysticus*, Salisb. Ann. Bot. ii. 75. *Nymphæa Nelumbo*, Linn.

In stagnant water throughout the Indo-Malayan region. Distrib. Persia, China, Japan and tropical Australia.

## ORDER VII. CAPPARIDEÆ.

Herbs, shrubs or trees, erect or climbing. Leaves simple or palmately 3 to 9-foliolate; stipules 2 or 0, sometimes spinescent. Inflorescence indefinite; flowers solitary, racemed, corymbose or umbelled, regular or irregular, usually 2-sexual. Sepals 4, free or connate, valvate or imbricate, rarely open in bud. Petals 4 (rarely 2 or 0), hypogynous or seated on the disk, imbricate or open in bud. Stamens 4 or more, hypogynous or perigynous, or at the base of or on a long or short gynophore. Disk 0, or tumid, or lining the calyx-tube. Ovary sessile or stalked, 1-celled; style short or 0; stigma depressed or capitate; ovules indefinite, on 2 to 4 parietal placentas, amphio- or campylo-tropous. Fruit capsular or berried. Seeds angled or reniform, exalbuminous; embryo incurved.—Distrib. Genera 23, species 300, chiefly tropical.

### 1. CLEOME, Linn.

Herbs. Leaves simple or digitately 3 to 9-foliolate. Flowers solitary or racemed, yellow, rose or purple. Sepals 4, spreading. Petals 4, regular or ascending. Stamens 6 to 20, sessile on the disk. Ovary sessile or with a short gynophore; style short or 0; ovules many, on 2 parietal placentas. Capsule oblong or linear, valves 2, separating from the seed-bearing placentas. Seeds reniform. Distrib. Species about 80, chiefly tropical.

1. *C. HULLETTII*, King, n. sp. A much-branched, sub-decumbent, small shrub; the stem striate, puberulous, and with a few short prickles in distant pairs. *Leaves* dimorphous; those of the lower part of the stem petiolate, trifoliolate, the leaflets obovate; those of the upper part simple, sessile, ovate; all pubescent and from .5 to .75 in. long. *Flowers* solitary, axillary, about .5 in. in diam. *Stamens* 6. *Pedicels* slender, much longer than the leaves. *Capsules* terete, striate, glabrous, about 1.5 in. long: seeds large, muricate.

Singapore, in dry place by road-sides.

This is allied to the Peninsular Indian species *C. aspera*, Koen, and *C. Burmanni*, W. & A., but differs from both in its dimorphous leaves.

2. *C. VISCOSA*, Linn. An erect, glandular-pubescent, viscid herb. *Leaves* the lower with long petioles, the upper sometimes sub-sessile, 3 to 5-foliolate; leaflets obovate or ovate. *Flowers* in terminal corymbs, on long pedicels. *Petals* yellow, reflexed, about .5 in. long. *Stamens* 12 to 20. *Capsule* glandular-pubescent, striate, narrowed to the apex, 2 to 3.5 in. long. *Seeds* small, reniform, transversely ridged. Hook. fil. Fl. Br. Ind. i. 170; Miq. Fl. Ind. Bat. i. Pt. 2, 97. Bl. Bijdr. 52; DC. Prodr. i. 242; Wall. Cat. 6968. *Polanisia icosandra*, W. & A. Prodr. 22; Wight Ic. t. 2.—Rheede Hort. Mal. ix. t. 33.

A common weed at low elevations in the tropics.

## 2. GYNANDROPSIS, DC.

An annual, glandular-pubescent or glabrate herb. *Leaves* 5-foliolate, long-petioled. *Flowers* racemed. *Sepals* 4, spreading. *Petals* 4, spreading, long-clawed, open in bud. *Stamens* 6, filaments adnate below to the slender gynophore, spreading above. *Ovary* stalked, ovules many. *Capsule* elongate, stalked: valves 2, separating from the seed-bearing placentas. *Seeds* reniform, black, scabrous.

1. *G. PENTAPHYLLA*, DC. Prod. i. 238. An erect, glabrous, or pubescent, spreading herb. *Leaves* on long petioles, quinate, the leaflets sessile, obovate or cuneate, acute or obtuse, entire or serrulate, 1 to 1.5 in. long. *Flowers* whitish or purple, in terminal racemes, .35 to .8 in., in diam., bracts 3-foliolate. *Capsules* cylindric, pointed, striate, nearly glabrous, 2 to 4 in. long. Hook. fil. Fl. Br. Ind. i. 171; Miq. Fl. Ind. Bat. i. Pt. 1, 96. W. & A. Prod. 21: *G. affinis*, Bl. Bijdr. 51. *Oleome pentaphylla*, Linn. Roxb. Fl. Ind. ii. 126.

Abundant in waste ground all over the tropics.

## 3. CAPPARIS, Linn.

Trees or shrubs, erect, decumbent or climbing, unarmed, or with stipular thorns. *Leaves* simple, rarely 0. *Flowers* white or coloured,

often showy. *Sepals* 4; free, imbricate in 2 series, or 2 outer subvalvate. *Petals* 4, sessile, imbricate. *Stamens* indefinite, inserted on the torus at the base of the long gynophore. *Ovary* stalked, 1 to 4-celled; stigma sessile; ovules many, on 2 to 6 parietal placentas. *Fruit* fleshy, rarely bursting by valves. *Seeds* many, imbedded in pulp, testa crustaceous or coriaceous; cotyledons convolute.—Distrib. Species 125, natives of all warm climates, except N. America.

*Synopsis of Species.*

Fruit globose or sub-globose.

- |                            |     |                                 |
|----------------------------|-----|---------------------------------|
| Flowers solitary, axillary | ... | ... 1. <i>C. Larutensis</i> .   |
| „ umbellate                | ... | ... 2. <i>C. sepiaria</i> .     |
| „ racemose                 | ... | ... 3. <i>C. Scortechinii</i> . |

Flowers supra-axillary, in rows of 2 or 3.

- |                        |     |                                  |
|------------------------|-----|----------------------------------|
| Leaves 3 to 4 in. long | ... | ... 4. <i>C. microracantha</i> . |
| „ 5 to 7 in. long      | ... | ... 5. <i>C. pubiflora</i> .     |

Fruit much elongate, cucumber-shaped.

- |                       |     |                                 |
|-----------------------|-----|---------------------------------|
| Fruit 4 to 7 in. long | ... | ... 6. <i>C. Finlaysonian</i> . |
| „ 3 in. long          | ... | ... 7. <i>C. cucurbitina</i> .  |

1. *C. LARUTENSIS*, King, n. sp. Scandent, the young branches and petioles densely covered with minute, rusty, sub-deciduous, tomentum. *Stem* sub-striate; prickles in pairs, short, hooked. *Leaves* glabrous, coriaceous, oblong-lanceolate, obtuse or retuse, the midrib prominent, the 5 or 6 pairs of nerves obscure; length 1 to 1.25 in., breadth 4 in., petiole .2 in. *Flower-pedicels* solitary, glabrous, more than half as long as the leaves. *Flowers* .75 in. in diam., white to pink. *Sepals* fleshy, glabrous, the outer pair ovate; the inner rotund, concave. *Petals* oblong, glabrous. *Stamens* about 12. Gynophore slender, nearly 2 in. long. *Fruit* globose, with an apical beak.

Perak, at Laroot, on trees. King's Collector, No. 5103.

A woody climber, 30 to 40 feet long. The petals change from white to pink. Ripe fruit is unknown. This must be near *C. erythrodasys*, Miq.

2. *C. SEPIARIA*, Linn. A scrambling shrub. Branches divaricate, with rather distant pairs of short recurved thorns, sub-striate, the younger puberulous. *Leaves* membranous, shortly petiolate, ovate to oblong, pubescent or glabrescent, nerves 4 or 5 pairs. *Flowers*, .35 to .5 in. in diam., in terminal umbels, the pedicels slender, .5 in long; buds globose. *Sepals* oblong. *Petals* narrow, white. *Ovary* apiculate, gynophore .25 to .5 in. long. *Fruit* pisiform, black. Hook. fil. Fl. Br. Ind. i. 177; Miq. Fl. Ind. Bat. i. pt. 2, 101; DC. Prod. i. 247; Roxb. Fl. Ind. ii. 568; W. & A. Prod. 26; Camb. in Jacq. Voy. Bot. t. 22; Dalz. & Gibs. Bomb. Flora, 10; Kurz. For. Fl. Burm. i. 66.



In hot dry places at low elevations, but not common in the Straits Settlements. Distrib. India, Ceylon, Philippines, Timor, Australia.

3. *C. SCORTECHINII*, King, n. sp. Scandent; young parts, and the inflorescence at all stages densely and minutely ferruginous-tomentose; older branches with 1 or 2 striæ, glabrescent; thorns stipular, in pairs, much shorter than the petioles, hooked. *Leaves* coriaceous, broadly lanceolate, acuminate, much narrowed at the base, smooth and shining above and the nerves obsolete; under surface ferruginous-tomentose when young, but becoming glabrescent, the midrib and 6 pairs of nerves bold and prominent; length 5 to 8 in., breadth 2 to 3 in., petiole .5 in. *Flowers* 1.5 in. in diam., on short lateral, leafy, bracteate, woody racemes. *Bracts* petiolate, ovate-acuminate, .75 in. long, deciduous. *Sepals* rotund, concave, tomentose externally. *Petals* pink, broadly elliptic, sub-ovate, blunt, notched, the base cuneate, glabrous. *Stamens* more than 20. *Fruit* globose, 3.5 to 4 in. in diam.; the gynophore transversely wrinkled, 2.5 in. long and .6 in. in diam.

Batang Padang district in Perak. King's Collector No. 8083. Scortechini, 191.

The fruit of this has been only once collected. The species is a fine creeper, 15 to 20 feet long. It closely resembles *C. trinervia*, Hf. & Th. in many respects: but the leaves are not triple but pinnate-nerved.

4. *C. MICRACANTHA*, DC. Prod. i. 247. Shrubby, not scandent, glabrous. Branches minutely striate; the spines in pairs, stipular, one-third the length of the petioles, divergent, polished, not hooked. *Leaves* thinly coriaceous, shining, minutely reticulate, broadly lanceolate to oval, acute, mucronate; the base narrowed or rounded; midrib stout, nerves 7 to 8 pairs; length 3 to 4 in., breadth 1.5 in., petiole .3 in. *Flowers* on short pedicels, 2 or 3 in a line, supra-axillary, 1 to 1.5 in. in diam. *Sepals* and *petals* oblong; the former puberulous, the latter white. *Stamens* 15 to 20, shorter than the gynophore. *Fruit* sub-globose, smooth. Hook. fil. Fl. Br. Ind. i. 179: Miq. Fl. Ind. Bat. i. pt. 2, 99: Blume. Bijdr. 52. *C. conspicua* and *C. Finlaysonian*, Wall. Cat. 6991 and 6992 A (not B).

Generally diffused at low elevations throughout the Malayan region. Distrib. Burmah. Sir Joseph Hooker gives the size of the ripe fruit (which I have not seen) as 2 to 3 in. in diam.

5. *C. PUBIFLORA*, DC. Prod. i. 246; var. *Perakensis*, Scortechini, MSS. A straggling shrub 15 feet long, branched from the ground. Branchlets compressed, striate, glabrous; thorns in pairs, minute. *Leaves* membranous, elliptic-oblong, shortly acuminate, the base narrowed or rounded, glabrous on both surfaces, nerves (9 to 10 pairs) and reticulations rather prominent; length 5 to 7 in., breadth 2 to 2.5 in.; petiole .25 in., stout,

channelled. *Flowers* 1 in. in diam. on long slender pedicels, 2 or 3 in a line, supra-axillary. *Sepals* oblong, concave, the two inner recurved, the two outer pubescent externally. *Petals* white, oblong, the two posterior united at the base by a gland so as to form a short spur. *Stamens* numerous. *Gynophore* about 1 in. long, pubescent as is the ovary.

Perak. Scortechini.

Collected only once, and without fruit. In Father Scortechini's field notes, he remarks that the petals are pubescent above and round the margin of the gland, and have a purple blotch.

A straggling but non-scandent shrub, almost unarmed, the thorns being very small. This variety differs from the type as described by De Candolle, and by Decaisne from Timor (Nouv. Ann. du Muséum, ii, 436) in having the venation of its leaves more straight and erect; otherwise it agrees.

6. *C. FINLAYSONIANA*, Wall. Hook. fil. Fl. Br. Ind. I, 179. Scandent, glabrous; the spines stipular, nearly straight, in pairs, very short, with broad bases and blackish rather blunt tips. *Leaves* coriaceous, shortly petiolate, broadly lanceolate to elliptic, shortly acuminate, slightly narrowed to the base; the under surface pale (yellow when dry) the midrib and 6 pairs of nerves very bold; reticulations minute, distinct on the upper surface; length 6 to 7.5 in., breadth 2.25 to 3 in., petiole under .5 in. *Flowers* (fide Hook. fil.) solitary or in pairs, supra-axillary, larger than in *micrantha*. *Sepals*, lanceolate, acute, glabrous. *Ripe fruit* solitary, on a long stout stalk of which 1.5 in. is pedicel and the remaining 1.5 in. carpophore, cylindric, tapering to the apex, 4 to 7 in. long, and 1 to 1.5 in. in diam., yellowish-red, glabrous. *Seeds* ovoid, smooth, .4 in. long.

Singapore, Wallich: Ulu Bubong in Perak.

Sir Joseph Hooker, who describes this species in the Flora of Brit. India from Wallich's Singapore specimens (which are accompanied by no field notes), is in doubt whether this is erect or scandent. Kunstler's field notes on the Perak specimens show it to be a creeper 20 to 30 feet long. It does not appear to be a common plant.

*Species of which the flowers are unknown.*

7. *C. CUCURBITINA*, King, n. sp. Scandent; branchlets finely striate, nearly glabrous; the thorns stipular, in pairs, hooked, very sharp, much shorter than the petiole. *Leaves* glabrous, shining, more or less broadly lanceolate or oblong-lanceolate, shortly acuminate, the base narrowed or rounded; main nerves 8 or 9 pairs anastomosing in bold intramarginal arches, the secondary nerves bold as is the midrib,

the reticulations distinct; length 5·5 to 7·5 in., breadth 1·75 to 2·25 in.; petiole under ·5 in., slender. *Flowers* unknown. *Fruit* cylindric, tapering to each end, the apex shortly beaked; when ripe orange-coloured, 3 in. long, and 1·5 in. in diam.; gynophore nearly ·75 in., pedicel 1·25 in., slender. *Seeds* ovoid, smooth, ·4 in. long.

Ulu Bubong, Perak. King's Collector, Nos. 10027 and 10795.

A creeper, 20 to 30 feet long; allied to *O. Finlaysoniana*, Wall. by its curious cucumber-like fruit, but with different leaves. *Flowers* have not as yet been collected.

8. *CAPPARIS KUNSTLERI*, King, n. sp. Scandent, the branches glabrescent: thorns stipular, in pairs, hardly ·1 in. long. *Leaves* membranous, oblong-lanceolate or oblanceolate, acute, the base narrowed, both surfaces glabrous, midrib and 7 pairs of sub-horizontal curving nerves prominent below; length of blade 4·5 to 5·5 in., breadth 1·5 to 2·25 in., petiole ·5 in. *Fruit* axillary, solitary, globose, 1·5 to 2 in. in diam., deep yellow; gynophore about 2 in. long, stout; pedicel rather shorter.

Gunong Bubu, in Perak, at an elevation of 800 feet, King's Collector, No. 8337.

A creeper, 40 to 60 feet long. Only fruiting specimens have been collected.

#### 4. *ROYDSIA*, Roxb.

Large unarmed woody climbers, branches spotted white. *Leaves* simple. *Flowers* yellow, racemed or paniced. *Calyx* 6-partite, segments 2-seriate, tips a little imbricate. *Petals* 0. *Stamens* indefinite, inserted above the base of the short cylindric gynophore. *Ovary* ovoid, 3-celled from the prolongation of the placentas; styles 3, subulate, or single and undivided; stigmas small, terminal; ovules many, 2-seriate in the angles of the cells. *Fruit* fleshy, with a woody 3-valved, 1-celled, endocarp, 1-seeded. *Seed* erect, cotyledons fleshy, unequal, longitudinally folded, the larger embracing the smaller.—Distrib. Species 3, tropical Asiatic.

1. *R. PARVIFLORA*, Griff. Notul. iv. 578; Ic. Pl. Asiat. t. 607, f. 1. A semi-scandent shrub, 4 to 8 feet high, glabrous, except the puberulous inflorescence and tomentose sepals. *Leaves* membranous, oblanceolate to obovate-elliptic, or sub-rotund, with an abrupt short blunt acumen; both surfaces shining, the midrib bold; primary nerves 5 or 6 pairs, prominent on the under surface, as are the intermediate nerves and reticulations; length 3·5 to 4 in., breadth 1·5 to 2·25 in.; petiole ·5 to 6 in., slightly thickened in the upper half. *Flowers* in long naked racemes arranged in a terminal leafless panicle much longer than the leaves, shortly pedicellate, ·2 in. in diam. *Sepals* 6, valvate, linear-oblong, sub-acute, densely tomentose on both surfaces, reflexed. *Stamens*

20 : filaments equal, not compressed : anthers innate. *Pistil* as long as the stamens ; gynophore shorter than the glabrous, 2-celled, ovoid ovary. *Stigmas* 3, globular, minute. *Fruit* unknown. Hook fil. Fl. Br. Ind. i. 409.

Perak. King's Collector, No. 1611. Distrib. Burmah.

2. *R. SCORTECHINII*, King, n. sp. Scandent, glabrous except the minutely pubescent inflorescence and sepals. *Leaves* membranous, elliptic or obovate-elliptic, shortly and abruptly acuminate, narrowed to the base ; upper surface shining ; the lower pale, the midrib and 6 pairs of arching main nerves prominent : length of blade 5·5 to 6·5 in., breadth 3 in. ; petiole 1·25 in., thickened in the upper half and bent in the middle. *Flowers* in terminal or axillary panicles or racemes, shortly pedicellate, ·25 in. in diam. *Sepals* 6, slightly imbricate in bud, united at their bases, linear-oblong, sub-acute, minutely tomentose on both surfaces, reflexed. *Stamens* 30 ; the filaments unequal, slender, compressed, united by their bases ; anthers innate. *Pistil* as long as the stamens, the gynophore shorter than the ovary, puberulous. *Ovary* glabrous. *Style* twice as long as the ovary, cylindric ; stigmas 3, sessile, ovate, small. *Ripe fruit* ovoid, smooth, yellow, 1·5 in. long and 1 in. in diam. ; endocarp membranous.

Perak ; Scortechini, King's Collector, Nos. 8464 and 4225 : in open rocky places from 500 to 1200 feet.

In his field note on No. 8464, the collector describes this as "a splendid creeper 80 to 100 feet long"; in that on No. 4225, he says, "a tree 40 to 50 feet high." Fr. Scortechini's specimens have no notes. From the flexuose appearance of the dried twigs, I believe this is a creeper, and not a tree. This and the last belong to the section of *Roydsia* characterised by having an undivided style, for which Sir J. D. Hooker, (F. B. I. i. 409), proposes the sectional name of *Alytostylis*, but with an expression of doubt as to whether it should not be separated off as a genus. To this group belongs also the Philippine species *R. floribunda*, Planch. An undescribed species from Burmah in the Calcutta Herbarium (Gallatly No. 499) also falls into this section.

##### 5. *CRATÆVA*, Linn.

Trees. *Leaves* 3-foliolate. *Flowers* large, yellow or purplish, polygamous. *Sepals* 4, cohering below with the convex lobed disk. *Petals* 4, long-clawed, open in bud. *Stamens* indefinite, adnate to the base of the gynophore. *Ovary* on a slender stalk, 1-celled ; stigma sessile, depressed ; ovules many, on 2 parietal placentas. *Berry* fleshy. *Seeds* imbedded in pulp.—Distrib. Species about 6, tropical and cosmopolitan.

1. *C. MACROCARPA*, Kurz in Journ. Bot. 1874, p. 195, t. 148, figs. 8 to

10. A small glabrous tree with pale smooth bark. *Leaflets* sessile, or nearly so, sub-coriaceous, obliquely elongate ob-lanceolate, the middle one narrower than the outer, rather bluntly acuminate, the base much narrowed; upper surface shining, lower pale dull with the midrib and nerves prominent; length 4 to 5 in., breadth 1·75 in. to 2·25. *Flowers* hermaphrodite, in terminal corymbose racemes, 2 to 3 in. in diam. *Petals* obovate, obtuse, unguiculate. *Stamens* 10 to 15, longer than the petals; anthers small, lanceolate, obtuse. *Ovary* ovoid, glabrous, the gynophore as long as the filaments; stigma sessile, discoid; placentas 2, parietal, multiovulate. *Ripe fruit* on a stout lenticellate carpophore 3 inches long, ovoid, smooth, purple spotted with grey, 2·5 in or more long by 2 in. in diam. *Seeds* embedded in pulp., compressed ovoid-reniform, smooth on the sides, shortly tuberculate along the edge, nearly ·5 in. long by ·35 in. broad.

Malacca, Maingay (No. 125 Kew Distrib.), Scortechini No. 1771, King's Collector, No. 10461.

A species distinguished by its sessile leaflets and flat ovate-reniform tubercle-edged seeds. Kurz's figure of the seeds is bad; as he confessedly worked with imperfect material in describing this plant. I have seen no authentic specimens of *O. magna*, DC, or *O. membranifolia*, (Miq. Fl. Ind. Bat. Suppl. 387) but, judging from the descriptions, they probably refer to this plant; in which case the older name (*magna*) would stand.

2. *C. HYGROPHILA*, Kurz J. A. S. B. Part II, 1872 p. 292; Journ. Bot. 1874, 196 tab. 148, figs. 6, 7. A small glabrous tree, with pale striate lenticellate bark; the youngest branches dark-coloured. *Leaflets* membranous, very shortly petiolulate, obliquely lanceolate, acuminate at both base and apex, the lower surface glaucescent; nerves about 6 pairs, sub-horizontal; length 3 to 4·5 in., breadth 1 to 1·25 in., petiole ·1 in. *Fruit* axillary, solitary or in fascicles of 2 or 3, cylindric, the apex with a blunt beak when ripe, brownish, spotted with grey, 4 to 5 in. long and 1·5 in. or more in diam.; the carpophore and pedicel each about 2 in. long, dark-coloured and faintly lenticellate. *Seeds* embedded in pulp., ·5 in. in diam., compressed but not flat, reniform, shortly muricate over the greater part of the surface.

Trang; King's Collector No. 1412. Distrib. Burmah.

Kurz founded this species on specimens from Burmah (in young fruit) which are now in the Calcutta Herbarium. The Malayan specimens (in mature fruit) agree with these. Kurz's drawing of the seed is misleading. For it was made from a young seed which had neither acquired its full size, nor its characteristic tubercles. Flowers of this species are as yet unknown; but the ripe fruit shows that they cannot

be in racemes as in the other species. The seeds approach in appearance those of *C. lophosperma*, Kurz, but are more tuberculate.

\* Besides the foregoing, there are in the Calcutta Herbarium specimens from Perak (King's Collector No. 818) of a *Crataeva* with leaves and flowers like *C. Narvala*, Ham. It is, however, described as having a thorny stem,—a character, so far as I am aware, not known in this genus. This is probably a new species, but, in the absence of fruit, I do not venture to describe it. The seeds appear to me to afford in this variable genus safer characters than any other part.

## Order VIII. VIOLACEÆ.

Herbs or shrubs. *Leaves* alternate, entire or serrulate, stipulate. *Flowers* regular or irregular, 2-bracteolate. *Sepals* 5, persistent, equal or unequal, imbricate in bud. *Petals* 5, hypogynous, equal or unequal, imbricate or contorted in bud. *Stamens* 5, filaments short, broad; anthers free or connate, their cells often with apical processes; connective broad, produced beyond the cells. *Ovary* sessile, 1-celled; style simple; stigma capitate truncate or cupular, entire or lobed; ovules many, on 3 parietal placentas, anatropous. *Fruit* a 3-valved capsule. *Seeds* small, albumen fleshy; embryo straight, cotyledons flat.—Distrib. Genera 21, species 240; natives of temp. and trop. regions.

Tribe I. *Violææ*. Corolla irregular, lower petal dissimilar. *Stamino-*  
*nodes* 0. *Capsule* loculicidal.

Sepals produced at the base ... 1 *Viola*.

Tribe II. *Alsodeiceæ*. Corolla regular. Staminodes 0. Fruit a loculicidal capsule.

## 2. *Alsodeia*.

1. VIOLA, Linn.

Herbs, rarely shrubby below. *Flowers*, on 1-, rarely 2-flowered peduncles, often dimorphic, some large petalled which ripen few seeds, others small petalled or apetalous and very prolific. *Sepals* produced at the base. *Petals* erect or spreading; lower largest, spurred or saccate at the base. *Anthers* connate, connectives of two lower often spurred at the base. *Style* clavate or truncate, tip straight or oblique; stigma obtuse, lobed or cupular. *Capsule* 3-valved. *Seeds* ovoid or globose.—*Distrib.* Species about 100, all temp. regions.

V. SERPENS, Wall. in Roxb. Fl. Ind. Ed. Wall. ii. 449 (not of Cat.), and DC. Prodr. i. 296; hirsute or glabrous, stolons or stems usually long, leafy and flowering; *leaves* ovate-cordate, obtuse or acute, crenate-serrate; stipules toothed or fimbriate, spur saccate; *sepals* acute; capsules

globose, few-seeded, glabrous or pubescent. Stigma very oblique or quite lateral, often minute and perforated. Hook. fil. Fl. Br. Ind. i. 184; Miq. Fl. Ind. Bat. i. pt. ii. 113; Royle Ill. 74, t. 18, f. 1; W. & A. Prodr. 32. *V. Wightiana* var. *pubescens*, Thwaites Enum. 20. *V. pilosa*, Blume Bijl. 57; Miq. Fl. Ind. Bat. i. pt. ii. 113.

Perak; on Ulu Batang Padang; L. Wray, Junior. Distrib. mountain ranges of India, and of the Malayan Islands.

## 2. ALSODEIA, Thouars.

Trees or shrubs. *Leaves* alternate (rarely opposite), distichous; secondary nerves often numerous and parallel. *Stipules* rigid. *Flowers* small, axillary or terminal, solitary, fasciated, cymose or racemose, regular; peduncles with many bracts. *Sepals* 5, subequal, rigid. *Petals* 5, subequal, sessile. *Stamens* 5, inserted inside or upon an annular disk; with long or short often broad dorsal membranous connectival appendages, the cells of the anthers sometimes with apical linear processes. *Ovary* ovoid; style straight, stigma terminal; ovules few or many. *Capsule* 3-valved, few seeded. *Seeds* glabrous in the E. Ind. species.—Distrib. Species about 50, chiefly tropical American.

Sect. I. *Prothesia*, Bl. (genus). Anthers with a subulate appendage from the apex of each cell, and a broad (usually dorsal) appendage from the connective.

1. *A. WALLICHIANA*, Hook. fil. and Th. Fl. Br. Ind. I, 187. A glabrous shrub. *Leaves* membranous, oblong-lanceolate to elliptic, shortly acuminate, entire or slightly serrulate, the base rounded or slightly narrowed; nerves 10 to 15 pairs, arching, prominent, their axils beardless; length of blade 9 to 12 in., breadth 2.5 to 5 in., petiole .5 to 1.5 in.; yellowish when dry especially on the under surface: stipules linear-lanceolate, glabrous, .75 in. long. *Racemes* shorter than the petioles, with many deciduous linear bracteoles. *Flowers* 4 to 8, pedicellate. *Perfect male flowers*; sepals acute, erect, lanceolate, equal to or longer than the petals. *Petals* oblong. *Filaments* short, attached to a 5-lobed fleshy disc. *Anthers* ovate with a small apical process on each lobe in front, and a single large orbicular hooded membranous appendage rising from the dorsum. *Pistils* rudimentary, or none. *Perfect female flower*; sepals spreading, ovate-acute, shorter than the petals. *Petals* erect, oblong obtuse, their apices recurved. *Filaments* longer than in the perfect male, the anthers without pollen. *Ovary* sessile, ovoid-conic, smooth; style cylindric. *Fruit* subglobular, obtusely 3-angled, granular, .35 in. long, dehiscing into 3 blunt valves. *Seeds* mottled.

Penang; Wallich. Perak; King's Collector, Soortechini.

The flowers in this species are practically unisexual and apparently

more frequently dioecious than monoecious. In flowers where perfect stamens occur the ovary is either absent or rudimentary; and in plants with a well developed ovary the stamens, although in most cases perfectly formed, contain no pollen. These sexual differences are accompanied by slight differences in the leaves, those of the male plants being oblong-lanceolate, narrowed to the base and serrulate, while those with female flowers have entire elliptic leaves with rounded or slightly narrowed bases. Specimens of the former, collected in Penang, were issued by Wallich as No. 4024 of his Catalogue under the name *Pentaloba macrophylla*; while specimens of the female were issued as Nos. 7501 and 7513 (un-named, but with the notes by R. Brown). These notes are as follows: on No. 7501, "*Urticeae habitu; arborescens;*" and, on No. 7513, "*Indeterminata fruticosa, decumb.; foliis alternis integerrimis, coriaceis, impunctatis, glaberrimis, pedunculis axillaribus.*"

Wallich was wrong in referring this plant to the genus *Pentaloba* of Loureiro, for that author describes no appendages to its stamens. It belongs most certainly to the genus *Prosthesis* of Blume (Bijd. 866.)

2. *A. KUNSLERIANA*, King, n. sp. A glabrous shrub or small tree; the branchlets striate, sometimes lenticellate. Leaves subcoriaceous, oblong-lanceolate, acuminate or caudate-acuminate, sometimes minutely and obscurely serrulate, very much narrowed to the base; upper surface smooth and shining; lower dull, rough from the numerous short transverse secondary nerves and 14 to 16 pairs of prominent ascending main nerves; the midrib bold and subrugose; the reticulations minute and distinct; length of blade 6 to 10 in., breadth 2·25 to 3 in., petiole ·25 to ·5 in. *Stipules* lanceolate, ·25 in. long. *Female flowers* in axillary, often crowded, fascicles or very short racemes of 3 to 8, bracteolate, the pedicels longer than the leaf-petioles. *Sepals* ovate, obtuse, imbricate, strongly nerved, the edges ciliate, shorter than the petals. *Petals* erect, the tips not reflexed, ovate-acute, rigid. *Stamens* with short flat filaments, each inserted into the apex of a lobe of the deeply 5-lobed disc. *Anthers* (without pollen) broad, adpressed to the ovary, each with 2 linear anterior and one large dorsally-attached halbert-shaped membranous appendage, the latter conniving into a cone round the upper part of the ovary. *Ovary* sessile, ovoid-conic; the style exserted, cylindric. *Capsules* ovoid, glabrous, shining, smooth, ·5 in. long, dehiscing into three narrow compressed pointed valves; *seeds* one in each valve, ovoid, white, shining.

Singapore; Wallich, King's Collector: Perak; Scortechini, King's collector; at low elevations. This species is more often practically monoecious than *A. Wallichiana*, to which it is closely allied. It differs, however, from that species in its much more acuminate rougher leaves, and also in its capsules and seeds.



3. *A. MAINGAYI*, Hook. fil. Fl. Br. Ind. i. 188. A small tree, glabrous except the inflorescence. *Leaves* membranous, nearly sessile, elliptic, acute or sub-acuminate, serrulate, the base rounded; main nerves 10 to 12 pairs, prominent below as are the transverse secondary nerves; length 5 to 6 in., breadth 2·5 to 2·75 in., petiole ·15 in.; stipules lanceolate, ·25 in. long. *Umbels* axillary, solitary, on peduncles ·5 in. long, 8 to 16-flowered; the bracteoles, small, ovate. *Sepals* imbricate, ovate-rotund, or broadly ovate, obtuse, villous in the middle externally. *Petals* longer than the sepals, ovate, concave, villous in the middle externally and with a villous line along the midrib internally. *Stamens* with short, thick, densely tomentose filaments inserted on a thick, sub-glabrous, fleshy disc: connective tomentose behind. *Anthers* elongate-ovate, with 2 ovate setose anterior, and 1 broad sub-terminal ovate, dorsal appendages. *Ovary* sub-globular, style thick, both densely villous-tomentose. *Capsule* ovoid, sparsely strigose, the valves acute. *Seeds* with a white spongy caruncle.

Malacca, Griffith.

4. *A. MEMBRANCEA*, King, n. sp. A tree or shrub, the young branches shortly pubescent or tomentose. *Leaves* thin when dry, obliquely obovate-elliptic, shortly and rather abruptly acuminate, serrate, the base narrowed, rather unequal-sided, both surfaces glabrous, except the midrib and 6 to 8 pairs of pubescent arching nerves, the reticulations wide; length 5 to 7 in., breadth 2·5 to 3 in.; petiole pubescent, ·5 in. long; stipules subulate, pubescent, 2 in. long. *Racemes* axillary, condensed, sessile, shorter than the petioles, few-flowered. *Sepals* 5, unequal, the outer 2 rather smaller than the inner, all broadly ovate-obtuse, pubescent externally. *Petals* 5, obovate-oblong, obtuse, the margins ciliolate with a few adpressed hairs on the back. *Stamens* 5, glabrous, the filaments very short, rising from a fleshy 5-lobed disc. *Anthers* broadly cordate or sub-reniform, with 2 small subulate processes on the apices of the cells and a large dorsal, cordate-acuminate, brown, membranous appendage as wide as the anther. *Ovary* sessile, ovoid, villose: style cylindric, glabrous; stigma cup-shaped. *Capsule* ovoid, glabrous, the valves in dehiscence blunt: seeds sub-globular with a beaked caruncle.

Perak at low elevations. Kings' Collector, Scortechini.

\* A shrub or small tree. This comes near *A. dasycaula*, Miq. in externals; but has fewer-nerved, more glabrous leaves.

5. *A. HOOKERIANA*, King, n. sp. A small glabrous tree, the branchlets lenticellate. *Leaves* membranous, shining, shortly petiolate, elongate-ob lanceolate or lanceolate, apex shortly and rather bluntly acuminate, entire or obscurely serrulate, gradually narrowed below the middle to the base; nerves 7 to 9 pairs, arching, slightly prominent; length 5

to 8 in., breadth 1·5 to 2 in., petiole ·25 in.; stipules ovate, only ·1 in. long. *Racemes* axillary, and on the older branches from the axils of fallen leaves, numerous, rather dense when young, afterwards sparse and open, from ·75 to 1·5 in. long, bracteoles linear, pedicels as long as or longer than the flowers. *Sepals* ovate, equal, pubescent or glabrous. *Petals* lanceolate with linear blunt apex, longer than the sepals, glabrous, or pubescent along the midrib externally. *Stamens* glabrous, the filaments as long as the rather deep disc. *Anthers* broadly ovate, the base cordate, almost sub-rectiform, the cells each with an apical point and with a broad membranous ovate acute dorsal appendage wider than the anther. *Ovary* sessile, pubescent; the style cylindric, glabrous; the stigma cup-shaped, truncate. *Capsule* ovoid, compressed, obtusely angled, glabrous, reticulate, ·5 in. long; the valves unequal, obtuse, compressed, sub-falcate: seeds sub-globose, pale, minutely mottled at the apex, the base with a papillate pitted caruncle.

Perak; at low elevations, Scortechini, Wray, King's Collector.

A tree from 20 to 30 feet in height; readily distinguished by its open, comparatively long, racemes. This closely resembles Blume's *Prothesia Javanica*.

6. *A. WRAYI*, King, n. sp. A sub-glabrous shrub, the branchlets with pale brown puberulous bark, rarely lenticellate. *Leaves* membranous, glabrous, shining, shortly petiolate, oblanceolate, shortly acuminate, distinctly serrulate, narrowed to the base, length 3·5 to 4·5 rarely 6 to 7 in., breadth 1 to 2 in., petiole ·1 to 2 in.; stipules linear, only ·1 in. long. *Racemes* very short, crowded, axillary or extra axillary, ·25 in. long; bracteoles broadly ovate, pubescent. *Sepals* lanceolate, tomentose externally. *Petals* oblong, obtuse, thickened and tomentose along the midrib. *Stamens* from the inside of a disc which is as deep as the filaments are long. *Anther* ovate-cordate, with a dorsal, ovate-acute, membranous appendage as broad as itself, and a terminal apical processes on each cell. *Ovary* sessile, densely villous as is the base of the cylindric style: Stigma sub-capitate. *Capsule* minutely fulvous-velvety when young, glabrous when old, ovoid with obtuse angles, 1·25 in. or more long and ·75 in. in diam.; the valves blunt, narrow. *Seeds* ovoid, brown, mottled, with sub-apical papillate pitted caruncle.

Perak; at low elevations; Scortechini, Wray, King's Collector.

A shrub 8 to 10 feet high. In respect of leaves very like *A. Hookeriana*, but smaller. The very short racemes, more hairy flowers and larger velvety capsules distinguish it, however, from that species.

7. *A. CINEREA*, King, n. sp. A glabrous shrub or small tree, the branchlets whitish, sparsely lenticellate. *Leaves* membranous, elliptic-ovate or lanceolate, sometimes oblanceolate, acuminate, narrowed at the base,

serrulate, pale when dry; nerves 8 to 10 pairs, slightly prominent below; length 4 to 6 in., breadth 1·5 to 2·5 in., petiole ·2 to ·4 in.; stipules scarious, pale, ovate-acute, striate, puberulous, ·25 in. long. *Racemes* terminal, 4 to 6 in. long, bearing numerous 2 to 5 flowered cymules; bracts broadly ovate, scarious, concave, striate. *Sepals* ovate, ciliolate. *Petals* oblong, obtuse, the apex undulate, erose or toothed, edges ciliolate. *Stamens* from the edge of a deep fleshy disc; filaments very short, glabrous: anthers ovate, with a broadly ovate appendage from the middle of the back curving over the apex, the cells divergent at the apex and each with a subulate terminal appendage. *Ovary* sessile, glabrous, globose: Style cylindric, with a few white adpressed hairs: stigma obliquely truncate, cup-shaped. *Capsules* ovoid, bluntly angled, glabrous, reticulate, ·75 in. long; valves blunt: seeds globose with an ovoid beaked hilum, pale, smooth.

Perak, at low elevations. King's Collector.

Var. *hirsutiflora*, King. *Sepals* tomentose externally; filaments sparsely villous; disc small: the cymules larger and the bracteoles longer and narrower than in the typical form.

Perak; Changkat Jerin. L. Wray, junior.

The whole plant when dried has a characteristic grey colour, and from this circumstance I have given its specific name.

Sect. II. *Pentaloba*. Anthers with a broad, usually terminal, appendage from the connective; but none from the cells.

8. A. LANCEOLATA, Wall. (*Pentaloba*) Hook. fil. Fl. Br. Ind. i. 188. All parts, except the inflorescence quite, glabrous; bark of the young branches pale. *Leaves* shortly petiolate, elongate-lanceolate, bluntly acuminate, the base much narrowed; nerves 9 to 12 pairs, sub-erect; slightly curved, prominent especially below, secondary venation transverse; length 5 to 8 in., breadth 1·25 to 1·75 in., petiole ·2 in. *Racemes* about ·5 in. long, 4 to 6-flowered, minutely bracteolate. *Flowers* on short pubescent pedicels. *Sepals* ovate, obtuse, thick, pubescent, about half as long as the petals. *Petals* lanceolate, acuminate, sparsely villous towards the middle. *Filaments* as long as the anthers, slender, glabrous, rising from a small glabrous disc; anthers linear-lanceolate with a single lanceolate terminal appendage. *Ovary* rudimentary in many flowers, sub-globose and, like the cylindric style, villous. *Fruit* sub-globose, minutely pubescent, ·35 in. long, valves in dehiscence beaked. Oudem. in Ann. Mus. Lugd. Bat. iii. 68; *Vareca lanceolata*, Roxb. Fl. Ind. i. 648. *Pent. lanceolata*, Arn. in Jard. Mag. Zoo. Bot. ii. 544.

Penang; Wallich, Stolickza, Curtis, King's Collector.

A shrub 6 to 8 feet high: apparently confined to Penang. This species is much more frequently truly hermaphrodite than some of

the others. The Sumatran species *A. dasypyxis*, Miq. comes very near this, but has longer racemes and more hairy fruit.

In *Alsodeia lanceolata*, Wall. there is a transition from *Pentaloba* to *Prosthesis*. Many of the specimens of *A. lanceolata* have the single terminal lanceolate appendage from the apex of the connective: others (Curtis's Penang specimen) have this appendage ovate and broader, while from the apex of each anther there is a rudimentary apical appendage, thus approaching *Prosthesis*.

9. *A. SCORTECHINII*, King, n. sp. A small glabrous tree, the branchlets usually pale brown. *Leaves* membranous, shortly petiolate, obliquely elliptic-lanceolate or oblanceolate, shortly and bluntly acuminate, irregularly serrulate; main nerves about 12 or 13 pairs, rather bold; secondary nerves transverse, slightly prominent below; length 7 to 9 in., breadth 2 to 3 in., petiole .2 in. *Racemes* sessile, about .5 in. long, several together, axillary or extra-axillary, about 3 to 5-flowered, with ovate bracteoles. *Flowers* pedicellate. *Sepals* puberulous, broadly ovate, much shorter than the petals. *Petals* 5, oblanceolate, with long bluntly acuminate exerted apices. *Stamens* glabrous, shorter than the petals; the filaments twice as long as the anthers, slender, rising from a deep, 5-lobed, slightly-notched disc; the anthers, short, ovate, with a single very small terminal appendage; ovary sessile, globose, glabrous, warted; style long, cylindric, glabrous or puberulous. *Ripe capsule* ovoid, pointed, rather more than .5 in. long, glabrous, lenticellate; valves compressed, pointed. *Seeds* 2 in each valve, sub-rotund, whitish, carunculate.

Perak; King's Collector, Scortechini, Wray; at low elevations.

A large shrub or tree 20 to 25 feet high. Externally this much resembles *A. Maingayi*, but the flowers, and especially the anthers, differ much.

10. *A. CONDENSA*, King, n. sp. A glabrous tree; the older branchlets pale, lenticellate. *Leaves* membranous, shortly petiolate, inequilateral, elliptic to elliptic-oblong, sub-acute, serrulate, gradually narrowed below the middle to the acute unequal base; shining above, darker and dull beneath; midrib and 13 to 15 pairs of prominent main nerves pale and sub-erect beneath, secondary nerves transverse; length 8 to 14 in., breadth 3 to 4.5 in., petiole .25 to .35 in.; stipules subulate, .35 to .5 in. *Panicles* axillary, crowded, much branched, spreading, 1 to 2.5 in. long, (longer in fruit) puberulous or glabrescent; the bracteoles numerous, ovate, acute. *Sepals* unequal; the outer 2 or 3 larger, rotund; the inner 3 or 2 ovate, pubescent on the back. *Petals* ovate, a little longer than sepals; rhomboid, with pale edges, villous on the back externally and along the midrib internally. *Stamens* glabrous, the filaments rather short, from a fleshy disc; anthers cordate, with a single terminal white

ovate membranous appendage. *Ovary* sessile, globose, glabrous. *Style* cylindric; *Stigma* cup-shaped. *Capsule* ovoid, pointed, glabrous, not lenticellate: valves compressed, pointed; seeds sub-globular, carunculate.

Perak, Scortechini, King's Collector; at low elevations.

A tree 30 to 40 feet high, approaching *A. Scortechini* in externals, but with different flowers.

11. *A. FLORIBUNDA*, King, n. sp. A shrub or tree, the young branches minutely fulvous-tomentose. *Leaves* membranous, shortly petiolate, oblong-lanceolate, ovate-lanceolate, sometimes elliptic, acute or acuminate, more or less obscurely serrulate; the base rounded, rarely acute; upper surface glabrous except the pubescent midrib and nerves; under surface minutely and softly tomentose, the midrib and 14 to 16 pairs of rather straight nerves and the transverse secondary nerves prominent; length 4·5 to 7 in., breadth 1·5 to 2·5 in., petiole ·1 to ·2 in.; stipules lanceolate, pubescent on the midrib, ·25 in. long. *Cymes* axillary, on peduncles 1 to 1·5 in. long, much branched, dichotomous, spreading, many-flowered; bracteoles oblong, obtuse, pubescent. *Sepals* unequal, the outer 3 ovate-rotund, the inner 2 ovate, all obtuse and pubescent. *Petals* ovate-oblong, obtuse, longer than the sepals, the apices usually reflexed. *Stamens* from a deep, pilose, 10-lobed, disc: filaments expanded and pilose towards the apex, contracted and glabrous below; anthers elongate-ovate, with a single connectival ovate terminal appendage. *Ovary* sessile, villous, tomentose; style cylindric, puberulous: stigma truncate, cup-shaped. *Capsule* ovoid, obtusely angled, adpressed-pubescent, ·35 in. long; the valves blunt; seeds sub-globose, angled; caruncle long, narrow.

Perak, at low elevations; very common.

Distrib. Sumatra; Lampongs, Forbes, 1719; Padang, Beccari. P. S. 683.

Usually a tree, and sometimes attaining the height (*vide* Kunstler) of 70 feet. But also, according to the same collector, found as a shrub 6 to 8 feet high. This is allied to the Burmese species *A. mollis*, H. f. and Th., which however, besides having the anthers of a *Prosthesis*, has much smaller cymes, and broader bracteoles and sepals.

12. *A. ECHINOCARPA*, Korth. in Ned. Kruidk. Arch. II, 360. A small tree, the young branches fulvous or ferruginous-tomentose. *Leaves* membranous, shortly petiolate, obovate or ovate-elliptic, abruptly and shortly acuminate, boldly and unequally serrate, the base rounded or narrowed; upper surface glabrous except the pubescent midrib and nerves; the lower softly pubescent, the midrib, 11 to 15 pairs of nerves and transverse secondary nerves pale and prominent: length 6·5 to 9 in., breadth 2·25 to 3·25 in., petiole ·1 to ·2 in.; stipules ·25 in. long ovate,

acute, pubescent margins the scarious. *Cymes* axillary and extra-axillary, sessile, condensed, 3 to 6-flowered; bracteoles lanceolate, keeled, pubescent. *Sepals* slightly unequal, ovate, obtuse, ribbed, tomentose externally, nearly as long as the petals. *Petals* oblong, obtuse, pubescent externally, glabrous internally. *Stamens* from a short glabrous disc; filaments longer than the anther, glabrous. *Anthers* narrowly ovate, the base cordate, with a single small terminal white appendage. *Ovary* sessile, densely villous, style sparsely villous: stigma truncate, cup-shaped. *Capsule* when ripe from 1 to 2 in. across, densely covered with brownish, tomentose, branched, felted fibres: valves compressed, blunt .75 in. long: seeds sub-globose, compressed, smooth, the caruncle ovate. Hook. fil. Fl. Br. Ind. i. 188; Miq. Fl. Ind. Bat. i. pt. 2, 116; Oudem. Ann. Mus. Lugd. Bat. iii. 79; Miq. l. c. iv. 216; Pl. Jungh. i. 122.

Singapore, Malacca, Perak, Penang, at low elevations. Distrib. Sumatra, Bangka.

Usually a small tree 20 to 30 feet high. Sometimes shrubby.

13. *A. CAPILLATA*, King, n. sp. A small shrub, the young branches rufous-tomentose. *Leaves* membranous, shortly petiolate, lanceolate, acuminate both at apex and base, serrulate; upper surface glabrous except the pubescent nerves and midrib; lower rufous-pubescent; the nerves about 11 pairs, bold, as are the transverse veins; length 6 to 7 in., breadth 1.5 to 1.75 in., petiole .25 in.; stipules lanceolate, pubescent externally. *Flowers* in small, sub-sessile, 3 to 5-flowered, axillary cymes. *Sepals* narrowly oblong, obtuse, tomentose externally. *Petals* linear-oblong, the apex sub-acute and reflexed, hairy along the midrib externally. *Stamens* alternating with the lobes of a deep, 5-lobed, glabrous disc; filaments slender, glabrous, longer than the anthers. *Anthers* small, ovate, each with an ovate acute small terminal appendage. *Ovary* sessile, globular, villous: style long, cylindric, sub-villous; stigma truncate, cup-shaped. *Capsule* .5 in. long, rusty—pubescent externally and densely covered with unbranched, often hooked, soft, pubescent spines about 5 in. long and not felted. *Seeds* ovoid, smooth, pale, with dark semi-circumferential band, and an oblong carunculus.

Laroot in Perak, King's Collector No. 2462. A small bush 4 to 8 feet high. This comes near *A. echinocarpa* and *comosa*, but differs notably in its flowers and seeds.

Section III. Anther cells each with a terminal subulate appendage; no appendage from the connective.

14. *A. COMOSA*, King, n. sp. A shrub or small tree, the young branches densely ferruginous-tomentose. *Leaves* membranous, sub-sessile, oblong-oblancoate, caudate-acuminate, serrulate, the base rounded; upper

surface glabrous; the lower pubescent, especially on the prominent midrib and 11 to 14 pairs of lateral nerves; length 5·5 to 7·5 in., breadth 1·5 to 2·5 in., petiole 2 in.; stipules subulate, '3 in. long. *Flowers* in dense axillary bracteolate glomeruli. *Sepals* ovate, obtuse, tomentose. *Petals* lanceolate, acuminate, pubescent externally, and (like the sepals) with an apical tuft of hairs, glabrous internally. *Stamens* from a short minutely toothed glabrous disc, the filaments shorter than the anthers: anthers narrowly ovate, each cell with a terminal apical seta, but without any appendage from the connective. *Ovary* elongate, sparsely villous; style pubescent; stigma truncate, cup-shaped. *Capsule* '5 in. long, flocculent-tomentose, densely covered with unbranched, subulate, soft, pubescent spines about '5 in. long, not felted. *Seeds* pale, ovoid, smooth, with sub-terminal papillate caruncle.

Perak, Wray No. 3299 and 1254; King's collector Nos. 406 and 554.

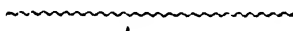
*Species imperfectly known.*

15. *A. PACHYCARPA*, King, n. sp. A small tree; the young branches pale, glabrous, sparsely lenticellate. *Leaves* membranous, oblong-lanceolate to elliptic-lanceolate, sub-acuminate, minutely and rather irregularly serrulate, the base slightly narrowed: both surfaces glabrous, the lower darker in colour; nerves 11 to 14 pairs, thin, but prominent below; length 5 to 7 in., breadth 2 to 3 in., petiole '4 in. *Sepals* rotund, pubescent, with thin glabrous edges. *Capsules* on short axillary branches, usually solitary, about 1·25 in. long; the valves boat-shaped, compressed, separating when ripe into two layers, the outer dark-coloured and pubescent, the inner pale, smooth, cartilaginous, and bearing the angular smooth carunculate seeds.

Perak, King's Collector No. 10235: Scortechini (without number).

A tree 20 to 25 feet high. Fresh flowers being unknown, the section of the genus to which this belongs cannot be determined. The capsules, however, show that it is a distinct species.

In addition to the foregoing, there are in the Calcutta Herbarium specimens of what appear to be five distinct species of this genus. The materials are, however, insufficient for accurate determination.



XXIII.—*On certain Lycænidæ from Lower Tenasserim.*

By WILLIAM DOHERTY, Cincinnati, U. S. A.

.[Received April 8th :—Read 3rd July, 1889.]

(With Plate XXIII.)

The following list includes most of the *Lycænidæ* taken by me in Tenasserim from January to March, 1889, inclusive. I have been unable to identify four or five *Arhopalæ* near *A. vihara* and *metamuta*. And I can only mention the few species of *Lampides* and *Nacaduba* which I happened to pin. Consisting wholly of low-country species (with but one exception), taken in the driest part of the dry season, the list represents only a part of the Tenasserim *Lycænidæ*. When all the species are known, those of the mountains and those of the valleys, those of the wet season and those of the dry, it seems to me quite possible that the number may be doubled.

The Mergui species were taken at the Taw-jaung monastery a few miles from the town, in low-country forest near the coast. The species marked *Myitta* were taken at my various camps in the Tenasserim valley, near the Siamese border, east of Tavoy. Except one species—*Surendra florimel*—they were all taken below one thousand feet altitude.

After devoting much time to the study of the structure of butterflies, and filling several note-books with descriptions of the young larvæ, tarsi, scent-organs, prehensors, scales, etc, I had in 1887 the great misfortune to lose most of them in the Malay Archipelago, together with a great collection of insects. The chief survivors were my notes on the egg, a part of my drawings of prehensors, and the descriptions of a few genera and species partly of this family which had been prepared for publication in 1886, some of which will appear in Mr. de Nicéville's "Butterflies of India." I have therefore been obliged to commence afresh, and as yet my material is too small to achieve one of my principal objects, a proper classification of the *Lycænidæ*. So the following attempted generalizations must be held as provisional only.

In 1886, I divided the family into six subfamilies, based chiefly on the form of the egg. To these another must be added, the *Liphyrinæ*, which besides our single Indian species, includes, perhaps, a few African forms. In four of the six other subfamilies, the egg seems to afford good characters for defining them, though a few small genera, which I have as yet studied but imperfectly, seem difficult to place. The two other groups, which I called the *Thæclinæ* and *Amblypodinæ* had better be united, forming a large mass of genera and species very difficult to arrange. In the *Amblypodias* especially, the egg seems to lose much of



its systematic value, and varies to a remarkable extent in forms much alike in general structure and appearance. So it is with great hesitation that I propose four sections based partly on it. Typically they are all four distinct enough, but seem to be connected by certain low forms of *Arhopala*, underlying them as it were, as if indicating the original ancestors from which they all sprang.

- |                                        |                            |
|----------------------------------------|----------------------------|
| Egg large, tubercular, indentations    |                            |
| obscurely hexagonal,...                | ... <i>Aphnæus</i> group.  |
| Egg similar, not tubercular,           | ... <i>Loxura</i> group.   |
| Egg small, tubercular, indentations    |                            |
| sharply cut, usually trigonal,         | ... <i>Thecla</i> group.   |
| Egg small, spiny, indentations sharply |                            |
| cut, tetragonal,                       | ... <i>Arhopala</i> group. |

The *Aphnæus* group has the egg convex above (as in all the subfamily), yellowish, large and coarse, overlaid with a thick, rough, vesicular, white or yellowish crust, covered with large blunt whelks or knobs (often but little elevated) and indented with obscure hexagonal spaces. This type of egg reaches its extreme form in *Neocheritra*, in which the indentations are fewest and coarsest, while in *Chrysophanus* they are numerous, and in *Curetis* numerous and cut into hexagons with some distinctness. In *Amblypodia*, as now limited, the egg is much the same as in *Neocheritra*, and the genus had better be put here. It resembles the *Arhopalas* in some things, but its venation shows it to be a very isolated form. The male has a fifth subcostal branch wanting in the female, and the middle discocellular, like the upper, is oblique, and greatly thickened, seeming to be the basal part of the lower radial vein. In *Iraota*, another genus hard to place, there is no middle discocellular, the radials having a common origin. Most genera of the *Aphnæus* group have elongate wings, with the outer margin of the forewing more or less oblique, and the costal and subcostal veins somewhat crowded together, the cell being near the costa (remote in *Arhopala*), which is but little rounded. The hindwing has two tails in most of the genera.

The *Loxura* group is obviously an offshoot of the *Aphnæus* group. The egg is large and white, without tubercles. In the typical genera, *Loxura*, *Yasoda*\* and *Eoöxylides*†, it has a cornice round the flat, table-

\* *Yasoda*, gen. nov. Differs from *Eoöxylides* in having but one tail; from *Loxura* in having only three subcostal veins (four in *Loxura*) in the forewing, and a large black sex-mark on the hindwing of the male above, on the lower median vein.

† I described this genus as *Marshallia*, naming it after Colonel G. F. L. Marshall, but the name turned out to be pre-occupied. As the name *Indoxylides*, which I proposed instead of it, seems to have reached Mr. de Nicéville too late to

like apex (which is less than half the diameter of the base), the surface very smooth, with numerous minute indentations, which, in occasional imperfectly developed specimens,\* are distinctly hexagonal. The other three Indian genera—*Drupadia*, *Biduanda* and *Suasa*—are less peculiar, and *Suasa* is obviously related to *Zeltus*, *Oheritra*, and other normal aphnæiform genera. Their eggs lack the subapical carina. In *Drupadia* and *Biduanda*, they are hemispherical, with rounded indentations larger than in *Loxura*. In *Suasa* the indentations are large, shallow, and distinctly hexagonal, looking as if impressed with a die. These six genera form a series, approaching the *Aphnæus* group, but have some features in common. They are all protected. The forewing is short and broad, the outer margin erect, the costa strongly arched, the hindwing elongate posteriorly. The prehensors are elongate and of a peculiar facies.

An *Arhopala*, apparently *inornata*, Felder, and one or two obscure allied species undescribed from Malayana, have eggs somewhat as in *Loxura*, but coarser and without the cornice. This peculiarity is associated with others in the imago, on which I shall form the genus *Iois*, the position of which is uncertain.

The *Thecla* group has much smaller eggs nearly always greenish, the lines enclosing triangular spaces, six of them radiating from each tubercle, which is roughly spherical, constricted at the base. This sculpturing, which is very distinctly cut, is elsewhere found only in the concave eggs of certain *Lycænince*. The section is a very indistinct one, its members tending to unite severally with the *Aphnæus* or *Arhopala* groups. I have had few opportunities of studying *Zephyrus*, and have never examined the true *Thecla*. As a group they seem to have both wings short and broad, the costa much rounded, the veins slender, the hindwing usually with one tail. *Surendra* may be distinguished from *Zephyrus* by the obsolescent discocellular veins. So far as these are visible, they are very upright, the middle one of the forewing unusually long, differing widely in these respects from all the succeeding genera,

be incorporated in his key to the genera of the *Lycænidae*, he has called it *Eoöxylides*. My description of the genus as well as those of my genera *Yasoda*, *Massaga*, *Aractes* and *Taraka*, all made in 1886, will appear in his next volume. I have recorded *Eoöxylides tharis* from Bassein, Burma, but it did not turn up in Tenasserim.

\* These curious eggs are usually rough or discoloured, and the sculpturing differs more or less from that of the others. I have found them in all the sections of the *Lycænidae*. They are usually exceedingly rare, but are more frequent in some *Arhopalas*, so that their eggs may fairly be called dimorphic. They are not immature, being quite hard, and at least occasionally produce perfect larvæ. I think they are atavisms, representing an earlier stage of development, the egg perhaps of some remote ancestor.

especially *Arhopala*. It includes four species resembling each other but slightly.

A number of species connect these genera with the *Arhopalas*. The egg varies greatly in these. *Panchala (ganesa)*, *Acesina* and *Flos* (genus novum) are distinguished by the long costal vein of the forewing, and the structure of the third and fourth subcostal veins, which, after their separation, are short, very unequal, and very close to the costa. In *Panchala* and *Acesina*, the costa of the hindwing is slightly tilted up at the apex, there is no lobe (a tail in *Acesina* only), and the underside is dull-coloured. In *Flos* the costa of the hindwing is regularly rounded, there is a conspicuous lobe and a tail, and the underside is richly marked. The type is *apidanus*, and the genus is widely distributed, occurring from the Himalayas to the Austro-Malayan islands. *Darasana* has the subcostal veins as in *Panchala* and *Flos*, but a very short costal vein in the forewing, the cell of which is more remote from the costa. It has no lobe or tail, and seems a tolerably distinct genus. Some species of *Flos* have an egg with triangular spaces. The typical species have, however, a small green egg with rough vesicular raised lines enclosing hexagons, and very small irregular knobs at their intersection. The egg of *Motamassyla* is somewhat similar, but there are no tubercles, and the reticulation is more delicate. The wings are not unlike those of *Zephyrus* in structure with an additional tail; the colouring is somewhat as in *Flos*.

In the *Arhopala* group the egg is a remarkable one. It is also rather small, delicate, usually green with raised white lines enclosing quadrangles (as in the *Deudoriginæ*), and bearing acute spines at their intersection. This type of egg occurs in all the large swift-flying *Arhopalas*, and in many of the smaller and obscurer kinds. They all have the costal vein of the forewing shorter than in *Flos* and its allies, and the subcostal branches normal. They agree with those genera, and differ from the other *Theclinæ* in the position of the cell, which is remote from the costa, and in the length, and slightly oblique direction of the upper discocellular vein. A number of the obscurer species have eggs with tubercles and triangles as in the *Thecla* group, but I do not know any structural points by which they can be separated from the rest.

The *Arhopalas* are extremely uniform in structure, as in aspect, and on account of their great numbers are difficult to arrange. In them it would be advisable to admit generic distinctions wherever it is possible to make them.

The *Thecla* and *Arhopala* groups agree in many particulars, one of the most striking resemblances being that of the prehensors, which in all the genera known to me are short and thick, the branches of the

unci stout, the clasps broad and truncate. A careful examination will probably result in the separation of the *Aphnæus* and *Loxura* groups from these under the name *Aphnæinæ*.

The small subfamily of *Deudoriginæ* is characterised in the male by the lower organ of the prehensors, the clasps or *harpagones*, being aborted and functionless, adhering to the intromittent organ. The abdomen of the female is pointed, and ends in a pair of long ovipositors. The egg is very small, green, covered with very numerous tetragonal spaces, bordered by raised transparent lines, very delicately carved, with little button-like tubercles at their intersection. The hindwing has always a very prominent anal lobe, a single tail at the end of the lower median, and a distinct angle at the end of the middle median vein. *Deudorix* and its allies belong here, as well as *Araotes*\* and *Sithon*. The genera *Bindakhara* and *Lehera*, which have also only one tail, can scarcely be included in any definition of the subfamily, nor *Neomyrina*, which has a very *Deudorix*-like egg.

The *Poritinæ* come near the *Aphnæus* group of the *Theclinæ*, I believe, the reticulations being hexagonal. On account of their relations with the *Lemoniadae* they might be placed at the head of the family. They can be distinguished by the joined costal and first subcostal veins of the forewings, a character occurring in *Sithon*, in many *Lycæninae*, and also, I observe, in a remarkable insect described as *Hypolycæna libna* and *Logania andersonii*, Moore, from Mergui, which may possibly connect *Poritia* with the *Lycæninae*. I have described the egg of *Poritia* in a former article. The base is quadrate, twice as long as wide, there is a square apex, two square sloping sides, and two vertical rhomboid ones.

The *Lycæninae* are distinguished by their decidedly concave eggs, broadest above the middle. The reticulations are often irregular, and vary greatly on different parts of the surface. Those on the sides consist of small white knobs constricted at the base, from which spring either four or six elevated lines, forming quadrangles or triangles. In *Oatopæcilma* the spaces are hexagonal, and in *Semanga* irregular. I include these genera here with much doubt; they are obviously transitional to the *Theclinæ*. The typical *Lycæna* group, containing the great majority of the subfamily, has hairy eyes, though the hairs are few and scattered in *Castalius* and *Zizera*. The *Pithecop*s group consists of naked-eyed genera, of which the eggs of *Megisba* and *Pithecop*s have tetragonal spaces, and *Neopithecop*s triangular.

\* *Araotes*, gen. nov. nearest *Sithon*, but with an additional subcostal vein in the forewing. The middle discocellular is obsolescent (distinct in *Deudorix* and its allies), the first subcostal touches the costal vein (united with it in *Sithon*, quite separate in the other *Deudoriginæ*), and there is but one tail (two in *Biduanda*, in which the type-species *laputhis* was placed by Mr. Distant).

I place here a few genera of dubious position. *Lyctenæsthes* with its spiculate egg, flattened above, shows affinities with *Deudoria*, but is connected with the *Lycteninae* by *Niphanda*, which (*N. tessellata*) has concave eggs. The egg of *Spalgis* is much flattened above, and delicately reticulated with irregular hexagons. Its position, like that of the following genera, can hardly be understood till the insects of tropical Africa, the great storehouse of low forms of *Lyctenidæ*, are better known. Next to *Spalgis* I place the singular genus *Taraka* (mihi), of which the type is *Miletus hamada*, Druce. This genus greatly resembles *Neopithecops*, and like it is probably protected. It may be separated from it by the narrow cell nearer the costa, and by the oblique discocellulars. From *Spalgis* it differs in the antennæ, which are much as in the *Pithecops* group, slender, annulated, with a short, distinct terminal club, while *Spalgis* has short stout antennæ, gradually thickened. The prehensors of *Taraka* are wholly lycteniform. The egg is remarkable, and bears a decided resemblance to those of the *Gerydinæ*, with which Mr. Druce first placed it. The apex is flattened, a little concave, irregularly reticulate, with a strong crenulated carina projecting both upwards and outwards, around the margin. Seen from the side, it is irregularly quadrate, a little widest at base, the sides smooth. The genus is evidently related to *Liphyra* and the older and more generalized forms of the *Gerydinæ* included in the genera *Logania* and *Malais*.

I have made a careful description of *Taraka mahanetra*, a very rare Malayan species somewhat resembling *Castalius elna* in colouring. I caught but a single pair of this species, and both I believe are now lost. Generally, they agreed with *T. hamada* in structure, but the forefoot of the female (as well as that of the male) was imperfect, and the joints of the tarsi immovable. As it is just possible that this peculiarity may have been due to gynandromorphism, I merely mention it, and reserve *hamada* as the type of the genus. The egg of *mahanetra* I, unluckily, do not know. The description of this species will appear in Mr. de Nicéville's work.

The *Gerydinæ* can best be defined by the prehensors, the egg, very abnormal in most of the genera, approaching the lycteniform shape in *Logania* and *Malais*. The clasps (*harpagones*) are small and normal. Fortunately, they are very variable in shape, and afford good specific characters, which are especially valuable in the difficult genus *Logania* and in *Allotinus*. The *unci* or upper organs are developed into immense knife-like blades, fitting into the tufted, scabbard-like, greatly elongate last joint of the abdomen. Each *uncus* has a branch, shaped something like a human femur or humerus, fitting to the middle of the under surface of the *uncus* with a ball-and-socket joint, and when at rest ap-

pressed to the edge of the blade, the tip, which is clavate and ends in a short hook not visible from the side, reaching the base of the uncus. This construction varies but little in all the genera and species of the group. A remarkable feature of the subfamily lies in the fore tarsi being in both sexes similar to the middle and hind ones, just as in *Fapilo* or *Hesperia*. This also occurs, according to Mr. Trimen, in certain African genera, such as *Arrugia*, which from his account of them seem to belong to this group. The legs of *Gerydus* are curiously flattened in both sexes, those of *Allotinus* and *Paragerydus* are long and slender, those of typical *Logania* have the ends of the tibiæ swollen. One or two species hitherto included in this last genus have the legs slightly flattened and very short and stout, the tibiæ being thickest in the middle. These fully deserve to form a separate genus, for which I propose the name *Malais*. It will include *L. marmorata* and *L. sriwa* (probably the same species), and one or two rare kinds undescribed, ranging from Pegu to Borneo. Since the preceding remarks were written, I have taken a true *Logania* in Upper Assam.

The egg is usually very much flattened, but, in *Logania* and *Malais*, it is scarcely more than twice as wide as high, as in many *Lycœnas*. Except in *Paragerydus* and a few *Allotini*, which have much flatter eggs, there is usually a number of strong lateral horizontal carinæ, two, three, four, or five according to the species, either simple or broken into short teeth. These teeth are placed in vertical series, one above the other, giving the outer margin of the egg, and indeed the egg itself if it is much flattened, the appearance of a cogged wheel. Thus the usual oblique reticulations of the *Lycœnidæ* give place on the outer border to vertical (the teeth) and horizontal (the carinæ) lines, a remarkable feature. The upper surface is, however, obliquely reticulated with delicate raised striæ.

This vertical reticulation is more pronounced in the egg of *Liphyra*, which, as might be expected from the strangeness of the insect itself, is very unlike that of other *Lycœnidæ*. It shows, however, an unexpected resemblance to that of *Logania* and *Taraka*. The egg is of great size, green, overlaid with white, shaped something like a section or "drum" of a Doric column, but somewhat widest at the base, the height, breadth at apex, and breadth at base being to each other as 9, 13, and  $15\frac{1}{2}$ . The top is marked with hexagonal reticulations, the lines turbinate in the middle, the margin deeply channelled, and then strongly carinate, the carina projecting both upwards and outwards, white, its contour even. The base is also obscurely carinate. The sides are crusted with white, and minutely indented, with about forty-five vertical ribs, slightly irregular and even (very rarely) anastomosing, extending also over the

outer part of the base, the inner part being green and minutely reticulated with hexagons. The prehensors I do not know. The foretarsi are, I believe, the same in both sexes, as in the *Gerydinae*.

*Liphyra brassolis* flies slowly with a distinct humming sound and an uncertain circling flight, hesitating a long time before alighting. Whether it is, as it seems, a protected species, or whether, as I believe, it flies chiefly at twilight and so escapes capture, I do not know. No one would ever take it for a butterfly; few moths are more typically moth-like in flight. It is probably the oldest type of *Lycænide* existing, and unconnected with the rest, except through such primitive dwarf forms as *Taraka* and the smaller *Gerydinae*. It is the only Asiatic representative of the\*subfamily *Liphyrinae* and its nearest allies are apparently African.

A word deserves to be spoken on the subject of green butterflies, since it seems one little understood at home. Early in the century Horsfield professed to have found a green female of the Javanese *Arhopala eumolphus*, the true female of which is blue. Recently, Mr. Distant has described, as the female of *A. farquharii*, a butterfly bright green over the basal half of the wings above. Now, the real female of *farquharii* (perhaps the form described as *A. maxwellii*, Distant) is violet-blue and one of the most constant of butterflies. Of the green form mentioned, I took several specimens in the Malay Peninsula and in Borneo, and they were all males. It is a rare species undescribed, perhaps identical with the Horsfieldian form.

Grant Allen shows that, while greenish flowers are among the oldest, really green flowers are the most recently developed of all and among the most conspicuous. Very much the same thing is true of *Lepidoptera*. Pale green moths, like *Actias*, *Geometra*, and *Pachyarches*, are protected by their colouring, which is common to both sexes, and are quite hidden when resting among the leaves. Such seems also to be the case with *Ichiora erya*\*, a lycænide which is greenish on the underside, and may possibly be the case with some *Catopsilias*. But bright metallic-green is, I think, the latest developed colour among butterflies, and decidedly the most conspicuous. No one who has not seen it can imagine the brilliancy of *Arhopala farquharii* or *Ornithoptera brookeana* in the greenest jungle. The brightest of the metallic-blue butterflies look dim beside them. It may be confidently asserted of all such butterflies that, unless the species is protected, only the male is green. The protected *Ornithopteras* have sometimes assumed green colours as well as golden

\* The underside is green or greenish in many South American *Theclæ*, but such cases are very unusual in Eastern *Lycænides*.

and orange, and the female shares in this useful ornamentation to some extent. In non-protected butterflies the green is confined to the upper-side, and is quite invisible except during flight. In the *Lycaenidae*\* it is found in many *Zephyri*, in some *Poritias* and *Massagas*,† in a few *Arhopalas*, and in *Lampides marakata*, a rare butterfly I discovered in the Malay Peninsula and named after its emerald tint above. Among all these, whenever the female is known, it is blue, orange, black, violet, or any other colour but green. The conservative and, in butterflies, unadorned sex, has not yet acquired the latest development in colours. It is also remarkable that the green colours seem to occur where the genus is most dominant. The Malay Peninsula and Borneo form the great centre of development of the genera *Arhopala* and *Lampides*, and it is there that most of the green species occur. The outlying *Arhopalas*, those of the North-West Himalayas, and the Timorian islands, are all blue. In *Zephyrus*, the green species are found only where the genus is best represented and most vigorous. *Zephyrus pavo*, a species found in the Bhutan and Assam hill-ranges, remote from the regular habitat of the genus, has, I discovered, the male blue and greatly resembling allied females from the Western Himalayas. The green and orange *Ornithopteras* also occur only in the heart of the *Ornithoptera* region. These remarks on green butterflies also apply in some degree to certain other *unusual* colours of great brilliancy, such as the shining coppery gold of *Ilerda brahma*, and the fiery red of *Thamala marciana*. It ought to be borne in mind that such colours must never be ascribed to a female without careful examination.

### Subfamily THECLINÆ.

#### *Arhopala Group.*

#### 1. ARHOPALA (NILASERA) CENTAURUS, Hew.

Mergui, Myitta.

#### 2. ARHOPALA ANARTE, Hew.

One male, Myitta. This is the form described, from Sumatra according to Kirby, by Hewitson in his Cat. Lyc. Brit. Mus., and is

\* Some rare species of *Neocheritra* are green above in some lights, especially *N. martina*, a Bornean species. The allied *N. hypoleuca* was also figured by Hewitson as green, apparently by mistake. The *Neocheritras* are among the swiftest and shyest of butterflies, and the bright colours of their upperside are only seen during flight.

† *Massaga*, gen. nov., nearest *Deramas*, Distant, but with only four subcostal veins in the forewing, instead of five. From *Poritia* it differs in the upper radial vein, which arises from the subcostal, a little beyond the end of the cell; in the cell of the hindwing, and in the markings of the underside, which are not annular but simple and linear. Sexes very unlike. Type *Poritia pediada*, Hew.



altogether different from the female (from the Malay Peninsula) described by him under the same name in the Diurn. Lepid. afterwards, the male of which has been named *agnis* by Felder, who recognised Hewitson's error. *Anarte* is one of the most beautiful of Tenasserim butterflies.

3. *ARHOPALA AGNIS*, Felder.

One female, Mergui.

4. *ARHOPALA ANTHELUS*, Doub.

Mergui, a very brilliantly coloured species.

5. *ARHOPALA SUBFASCIATA*, Moore.

Myitta. The costal and apical black is somewhat wider in the female, which does not differ greatly from the male.

6. *ARHOPALA PASTORELLA*, n. sp., Plate XXIII, Fig. 12.

Male above light cerulean blue, brilliantly metallic, outwardly slightly virescent and less resplendent; forewing with a slender black marginal and costal line, hindwing blue from the costal vein to the submedian, a marginal black line. *Below* rather dark fuscous brown, the markings darker, bordered by slightly paler lines, only the basal spots annular, the other like parentheses, so ( ). *Forewing* with three in the cell, a transverse one below it, and one in the base of the lower median space. The transverse discal band is rather broad, the first four spots united and compact, the first small, close to the costa, the second broadest, the fifth and sixth dislocated inwardly, compactly united; a submarginal row of obscure dark spots bordered within and without by obscure paler touches. *Hindwing* with the basal spots of moderate size, annular, a transverse discal series of nine spots in a tolerably regular semicircle, all somewhat annular, none approaching the terminal cell-streak; a submarginal row of obscure dark cordate spots bordered with paler, a slight metallic green streak in the lower median space, and a similar band from the lower median to the submedian vein, both bordered with black. The lobe is small, black; there are slight projections at the end of the lower median and submedian veins, but no distinct tails; the outer margin is regularly rounded without undulations. Expanse two inches.

Myitta. In the colour of the upperside this butterfly perhaps resembles *A. lycanaria*, Felder, a small species and tailed. It is very near *agelastus*. But that species is more violet apically, and not distinctly metallic above; below, the transverse bands are more regular; the costal spot of the forewing absent, and the general colour duller, more fuscous and less rufous.

7. *ARHOPALA AGELASTUS*, Hew.

A common species, Mergui, Myitta, where one or two similar forms

occur which may or may not be distinct from it Mr. de Nicéville has pointed out to me that on the forewing of the male of the allied *A. antimuta* there is a curious clouded disc, perhaps of the nature of a sex-mark. This is sometimes just traceable in *agelastus*.

8. *ARHOPALA VIHARA*, Feld.

Mergui. I obtained several species of this very difficult group, but not having access to authenticated specimens of the allied species *aroa*, *atosia*, *yendava*, etc., I am unable to identify them.

9. *ARHOPALA METAMUTA*, Hew.

Mergui, Myitta.

10. *ARHOPALA DAVISONII*, de Nice, MS.

Mergui, Myitta, Tavoy. This species, which is quite distinct from the preceding one, belongs to a most difficult group which can hardly, I think, be understood without a careful study of the prehensors. *A. davisonii* is one of the commonest and most ubiquitous of Malayan insects and is abundant in Borneo.

11. *ARHOPALA DUESSA*, n. sp., Pl. XXIII, Fig. 6.

Male above bright cerulean blue over fully half of the forewing, the apex widely, the costa and outer margin moderately, and the veins slenderly black. Hindwing with the cell and extreme base of the lower median space irrorated with blue-scales. Below light brown, the costal and apical half of the forewing, including the upper half of the cell, and all the hindwing, glossed with pale violet, the markings violet brown with violet-whitish irides, only the basal ones annular. Forewing with three transverse spots in the cell, a double one in the basal part of the lower median space, a very broad compact dark transverse discal band unbroken from the costa to the submedian vein; the apex with a whitish patch. Hindwing with basal annular spots, an irregular one at the end of the cell, outwardly acuminate, and a very irregular transverse discal band of which the first and second spots are compactly united with the terminal cell-spot, the other five small and separate, forming an irregular chain; an outer discal pale fascia forming a large violet-whitish mass near the apex, the disc also clouded with whitish; an obscure submarginal line of pale violet lunules, the marginal line dark. No metallic subanal markings. Forewing distinctly undulated outwardly, hindwing without tails, lobes or undulations. Expanse  $1\frac{1}{3}$  inch.

Two males, Myitta. I know no species closely resembling this. It may be allied to *bazalus*, but has no tail or lobe. The distribution of the blue on the upperside is very unusual.

12. *ARHOPALA PERISSA*, n. sp., Pl. XXIII, Fig. 11.

Male, above rich uniform purple blue over fully half the forewing and two-thirds of the hindwing. Forewing with the costal border and

lower angle narrowly, and the apex widely black. Hindwing with the costa widely and the outer margin narrowly black, the blue extending beyond the submedian vein. *Below* dull fuscous-brown, the markings but slightly darker, bordered by lines a little paler, only the basal spots on the hindwing annular, the others with straight borders. *Forewing* with three spots in the cell and a broad uniform band, unbroken and but slightly curved from the third subcostal to the lower median vein, the base of the lower median space and the upper and basal part of the inter-no-median space dark, separated distinctly from an outer pale area in that space; a submarginal line of obscure darker spots bordered by a slightly paler line. *Hindwing* with the basal spots small and well separated, a streak across the end of the cell extending to the submedian vein, and a transverse discal band dislocated outwardly below the lower subcostal vein, continuous in the next four spaces; submarginal markings as on the forewing, a metallic green fascia from the lower median to the submedian vein, and a touch of it in the lower median spot. The hindwing is distinctly undulate outwardly; it has no tail and but slight traces of a lobe. Expanse  $1\frac{1}{2}$  inch.

Myitta. I know no species closely resembling it. It is a richly coloured butterfly above, but the underside is unusually dull.

13. *ARHOPALA MIRABELLA*, n. sp.

Male above bright violet-blue, dull violet in some lights, over fully five-sixths of the forewing, the marginal black band moderate and nearly equal on both wings. *Below* light fuscous, glossed with pale violet, the markings large, numerous, distinct and crowded, consisting of deep brown spots, paler in the middle, set in distinct violet-whitish rings or parenthetic lines. *Forewing* with the three usual cell spots large, a double series of costal marks, the transverse band much broken, the spot in the lower radial space (the fourth) extruded; no distinct marks below the cell, two submarginal violet-whitish lines, the inner lunular, the outer straight, obscure. *Hindwing* with the basal spots annular, the basal costal one obsolescent; the transverse discal band with only the first pair of spots continuous (the second touching the terminal cell-spot which is large, parenthetic), the others irregular, the third dislocated outwardly, the fifth inwardly; two submarginal lunular lines, the anal angle with three small black spots bordered with metallic green, behind which is a narrow irrorated whitish fascia. *Female* with the blue somewhat paler and covering only half the forewing, and the hindwing from the costal vein (basally) and the upper subcostal almost to the submedian; the dark border rather wide. Both sexes have a slender tail tipped with white, and a small, distinct lobe. Expanse  $1\frac{1}{2}$  inch.

A male from Mergui, a female from Myitta. Nearest *A. alitæus*,

Hew. from the Celebes, but seems to be darker below, with a broader black border above. From *achelous*, Hew. it also differs in the broader black border, and the apex of the hindwing below is not lilac. The blue above seems also darker and richer. From *aida*, de Nicéville, it differs in the strong violet gloss and the large and crowded annulations, occupying most of the cell of the forewing and extending thence nearly to the costa, on the underside; the upperside is very similar. The figure of *A. mirabella* was omitted by accident.

14. *ARHOPALA BELPHÆBE*, n. sp., Plate XXIII, Fig. 18.

Male, above light, rather dull purple-blue over about half of the forewing, the dark border wide on the hindwing. *Below* much like *mirabella*, but the costal markings of the forewing are absent, and the transverse discal band is composed of spots nearly annular on the forewing and entirely so on the hindwing. The three upper spots on the forewing form a line outwardly oblique, the next two are united. *Hindwing* with the three basal spots small and crowded together, the others large, distinctly outlined with violet white, that at the end of the cell irregular, produced outwardly to a point in the lower median space as in *A. duessa*; the transverse band annular, nearly regular, composed of slightly united pairs, the middle pair out of line; a double line of obscure pale submarginal lunules on both wings. Expanse  $1\frac{1}{2}$  inch.

*Myitta*. This species is something like the female of the preceding one, but the blue is paler and more lilacine. It has no tail and scarcely any lobe. It has also some resemblance to *A. agesias* from Borneo.

15. *ARHOPALA ALBOPUNCTATA*, Hew.

*Myitta*. This species, like *A. theba* and *A. aronya* from the Philippines and a beautiful undescribed Celebesian species, mimics the genus *Lampides* both on the upper and underside, resembling *L. elpis* and its allies. Another *Arhopala* (*critala*, Felder, from the Moluccas) mimics the *danis* group of *Cyaniris* most faithfully.

16. *ARHOPALA AMMON*, Hew.

*Myitta*. The Tenasserim form of this beautiful little species may be distinct from the Malayan one, but in the absence of an authentic specimen of the latter I cannot at present decide.

17. *ARHOPALA FARQUHARII*, Distant.

This species seems quite distinct from *eumolphus*, not, as Mr. Distant says, on account of the dislocated transverse band of the forewing, which often occurs in *eumolphus*, but on account of the uniform dull brown colour of the underside, the pale rings enclosing slightly darker brown spots, while in *eumolphus* the wings are washed with bronzy grey, the ground colour varying in different places, the spots small and distinct, while the anal green area is usually obsolescent. The female of *farquharii*

is bright blue over fully half the forewing, its edge serrate, with a wide brown border on both wings, darkening where it borders on and deeply indents the blue subapically. The species is extremely uniform everywhere, and is abundant from Tavoy and Mergui to south-eastern Borneo.

18. *ARHOPALA HELLENORE*, n. sp., Plate XXIII, Fig. 7.

Nearest *eumolphus*. The green of the upperside is rather more tinged with golden, and the dark border is somewhat narrower on the forewing and much narrower on the hindwing, extending less than a third towards the base of the lower median space. Below both wings are conspicuously marked with whitish, which forms a large apical mass on the hindwing in which the transverse markings are very distinct, and across both wings in an obscure discal band. The subanal metallic green markings are obsolescent. The dark markings are large, as in *farquharii*, from which it seems quite distinct, though it may be the local Tenasserim form of *eumolphus*. One male, Mergui. Expanse  $1\frac{7}{8}$  inch.

19. *ARHOPALA MAXWELLII*, Distant. ( ? ).

I am uncertain whether, as Mr. de Nicéville suggests, the female taken by Mr. Biggs and figured by Mr. Distant as *A. maxwellii*, is really the female of *farquharii*, or whether, as I thought at first, it is the female of a male taken by me at Myitta. This is a dark violet-blue butterfly, very much like *agaba* above, but singularly like *farquharii* below, distinguished, however, by the large distinct basal spots of the hindwing, the large costal spot of the forewing opposite that at the end of the cell, and by the first four spots of the discal band forming a very regular quadrate mass. Neither by the figure nor the description can I distinguish it from *maxwellii*. But Mr. Distant is much more likely to have obtained *farquharii*, which is abundant, than this species, which is rare, and Mr. de Nicéville's theory is probably correct. In that case my male remains unidentified.\*

20. *ARHOPALA (SATADRA) AGABA*, Hew.

Myitta, Tavoy.

21. *ARHOPALA (SATADRA) AIDA*, de Nice, MS.

Mergui, a very common species. In typical species of *Satadra*, such as *atra* and *rama*, the tail and lobe are well developed, but in others they tend to disappear, so that it would be hard to define the genus.

22. *MAHATHALA AMERIA*, Hew.

Mergui, Myitta, common.

\* Since this was written I have learned that Mr. de Nicéville will describe this species as *Arhopala adorea*.

*Thecla Group.*

23. *APPORASA ATKINSONII*, Hew.

The genus and the species were both, I believe, founded on a single specimen of uncertain sex and with the tails broken off. I took one male and two females near Myitta, having spatulate tails much like those of *Mahathala*. They differed from that genus in the less acuminate apex of the hindwing, in the egg (which was covered with triangles and tubercles instead of quadrangles and spines, a difference apparently of small importance in these butterflies), and in the more undulate margin of the hindwing, which gives it a most peculiar appearance. But the insect has, when sitting on a tree-trunk, a marvellous resemblance to a patch of lichen, and the irregular outline adds to this effect. Mimicry of this sort is a sign of great flexibility of structure and such genera must be judged by severer canons than others; so that it is doubtful whether *Apporasa* can stand.

24. *DARASANA PERIMUTA*, Hew.

Mergui, Myitta.

25. *FLOS APIDANUS*, Cram.

Mr. Distant makes no mention of the singular scarlet costal area at the base of both wings below in this species, though they had long ago been observed by Cramer and Godart. They are occasionally present, though much less marked, on the forewing of some of the Himalayan species of this genus, as Mr. de Nicéville has shown me.

One female, Mergui. This species is the type of my genus *Flos*, the life-history of which I hope to publish before long. I have taken it in Eastern Java, and slightly different forms occur in the Celobes and in the mountains of Sambawa. For a partial description of *Flos*, see above.

26. *FLOS ABSEUS*, Moore.

Myitta, agreeing perfectly with Sikkim specimens.

27. *FLOS ARTEGAL*, n. sp., Pl. XXIII, Fig. 5.

Male, above, base azure, darkening outwardly to violaceous blue, quite violet in some lights; on the forewing the blue occupies less than half of the surface, the black border reaching the upper angle of the cell, and extending unusually far up the hind-margin. *Hindwing* with a blue area from the costal and upper subcostal veins to the submedian, its outer margin irregular, the black border wide. *Below, forewing* light brown, the costal half glossed with violet, a large triangular violet-whitish area (somewhat as in *Elymnias*) on the costa near the apex; three wide dark violet-brown transverse bands, edged with paler, one in the cell; the second across its end, extending from the second subcostal to the lower median; the third oblique, unbroken, with straight

sides, from the costa to the upper median, continued irregularly almost to the lower median; margin, except at the apex, dark, a marginal blackish line. *Hindwing* very deep chocolate brown, a paler, violet-glossed band, edged by a paler line, across it from the costa to the submedian vein, crossing the cell; beyond this a dark transverse band; apex with a large dark area, its margin violet-whitish; disc mostly glossed with violet, its lower part irrorated with violet-whitish scales; a dark submarginal fascia, rather wide and conspicuous subanally; an obscure metallic-green and black ocellus in the lower median space, and one on the lobe, the green extending to the submedian vein. The forewing is rounded outwardly, the hindwing slightly scalloped, with a distinct lobe and a very short tail at the end of the lower median vein. Expanse  $1\frac{1}{2}$  inch. In its small size and short tail it differs from the other species of the group. Two males, Mergui.

28. *SURENDRA QUERCETORUM*, Moore.

Myitta.

29. *SURENDRA AMISENA*, Hew. (*Rapala amisenæ*, Dist.).

Mergui, Myitta. The female agrees well with Hewitson's figure, except that the transverse discal line of the forewing below is more irregular, and like that of his figure of *Surendra vivarna*. The male differs from Distant's figure in being more angulate, the forewing being acuminate and slightly falcate. The blue area above varies greatly, sometimes occupying less than a third of the forewing and a sixth of the hindwing, sometimes more than half of the forewing and a third of the hindwing. In this species the male has a short tail at the end of the lower median vein, but scarcely more than an angle at the end of the middle median; the lobe is much smaller than in *S. quercetorum*. The female has two tails, both slender, the outer the shorter.

30. *SURENDRA FLORIMEL*, n. sp., Pl. XXIII, Figs 17, ♂; 4, ♀.

Male, above, rich purple-blue, from the costal vein to the hind margin, the blue area outwardly angled at the upper median vein, and occupying nearly half of the forewing. On the hindwing it extends from just below the lower subcostal to the submedian vein, leaving the upper part of the cell dark; a narrow black marginal line. *Below* the ground is light fuscous brown as in *amisenæ*, but with the cell and disc of the forewing much darker and the basal and apical half of the hindwing deep violet brown. *Forewing* with a short oblique dark streak in the middle of the cell, a larger one across its end, and one or two costal ones; a transverse discal line of joined lunules (separated in *amisenæ*) from the second subcostal to below the lower median, projecting outwardly below the lower radial vein; apex widely and outer margin narrowly pale fuscous. *Hindwing* with the transverse discal fascia con-

sisting of a broken, dull silvery line on a deep-brown ground, an obscure outer-discal transverse band, pale on the dark apical and dark on the pale abdominal ground; an obscure metallic patch in the lower median space.

Female, above, dull brown, a slightly paler area in the middle of the disc. Below the dark area of the forewing is confined to the neighbourhood of the median spaces on the disc, that of the hindwing to a band across the wing from the apex to the hind margin, crossing the end of the cell; a distinct whitish spot basally between the costal and subcostal veins, the inner transverse line united, crossing the dark area subapically; the outer one consisting of pale lunules bordered, especially outwardly, by a dark band, in which there are two dark subapical spots, the second larger. Expanse  $1\frac{1}{2}$  inch. This species has the hindwing strongly angled at the end of the middle median vein, and quite straight, thence to the anal angle; there is no trace of tails or lobes. The forewing is not falcate in either sex. The egg and venation are as in *amisena* and *quercetorum*. It is a very distinct species, and the male is very richly coloured.

One male and several females taken on the pass near Wagung, Tavoy district, at 1,500 ft. altitude.

*Loxura Group.*

31. *LOXURA ATYMNUS*, Cram.

Mergui, Myitta.

32. *YASODA TRIPUNCTATA*, Hew.

Mergui.

33. *DRUPADIA MOOREI*, Distant, (*boisduvalii*, Moore).

Mergui, Myitta, common. I cannot find any constant difference between Mergui and Perak specimens. The genus *Drupadia* differs from *Biduanda* in having the third subcostal vein undivided (in *Biduanda* it is forked just before its termination) and a conspicuous sex-mark on the hindwing above, between the bases of the costal and subcostal veins. Nevertheless, the two are extremely similar in the entire structure of the egg, the larva, and the imago; and in any system of classification ought to be brought together.

34. *BIDUANDA THESMIA*, Hew. (*fabricii*, Moore).

Mergui, Myitta. I cannot find any constant difference between Mergui and Perak specimens.

35. *BIDUANDA MELISA*, Hew.

One male of this rare little species, Myitta. A similar kind occurs at high elevations in Perak, but whether it is this species or *B. scæva*, Hew., I am unable to say.



36. *BIDUANDA NICÉVILLEI*, n. sp., Plate XIII, fig. 16:

Male, above, violet (much richer and bluer than in *B. thesmia*), slightly paler in the middle of the forewing, a narrow, even black border. *Hindwing* with two subanal black spots bordered inwardly by an area irrorated with whitish scales; a marginal black and white line subanally, the cilia partly white, as well as most of the tails. *Below*, much like *B. melisa*, the markings more rufous, less fuscous, the basal spots simple, not annular, the transverse discal band and the outer margin of the forewing rufous brown and ferruginous of various shades, the apical part of the outer margin of the hindwing light ferruginous, the metallic green area large, extending unbroken from the upper median to the internal veins, the submarginal line straighter, and less undulated on both wings. Expanse an inch and a half, the species being larger than either *melisa* or *scudderii*. Two males, Myitta.

I name the species after Mr. Lionel de Nicéville, whose great work on Indian butterflies, equally important for the information which it contains, and for the impetus which it is certainly destined to give to the study of insects in the East, is now in progress.

37. *BIDUANDA SCUDDERII*, n. sp., Pl. XXIII, Fig. 14.

Allied to *thesmia* and somewhat resembling the female of that species. Male, above, dark fuscous, an orange area occupying about a sixth of the forewing, including the lower angle of the cell, and the disc from the base of the lower radial to below the lower median vein; a somewhat large, obscure violet-blue subapical area (not refulgent in any light), not reaching the costa or the outer margin; the hind margin is also tinged with violet. *Hindwing* dull fuscous, a large dull violet area from the cell to the outer margin, between the lower subcostal and the lower median vein, from the cell to the marginal black line, its inner part densely irrorated with bluish-white scales, beyond which lies a transverse darker discal fascia; subanal area nearly black, cilia whitish subanally; tails chiefly black except at the tip. *Underside* much as in *thesmia*, expanse as in *melisa*. One male, Mergui.

I name the species after Mr. S. H. Scudder of Cambridge, Massachusetts, the first numbers of whose magnificent work on the New England butterflies I have just had the good fortune to meet with.

38. *SVASA LISIDES*, Hew.

Myitta.

*Aphnæus Group (Aphnæinæ ?).*39. *AMBLYPODIA NARADA*, Horsf.

The Mergui form (*andersoni*, Moore) seems identical with that found in the Malay Peninsula. It is of a brighter, richer blue than the North Indian variety.

40. *TICHERRA ACTE*, Moore.

Mergui, Myitta. My single female (Myitta) is remarkable in having the white spots on the lower part of the hindwing united into a short very broad band, such as occurs in some specimens of *Oheritra freia*.

41. *CHERITRA FREIA*, Fab.

Mergui, Myitta.

42. *BINDAHARA PHOCIDES*, Fab.

One female, Mergui.

43. *ZELTUS ETOLUS*, Fab. (*etolus*).

Mergui, Myitta.

44. *SINTHUSA AMBA*, Hew.

Myitta. Differs from *S. nasaka* in the richer blue of the forewing, and the much broader blue area of the hindwing.

45. *HYPOLYCENA ERYLUS*, Godt.

Mergui, Myitta.

46. *CHLIARIA OTHONA*, Hew.

Myitta.

47. *CHLIARIA MERGUIA*, n. sp., Pl. XXIII, Fig. 2.

Male, above, dull indigo blue over half the forewing from the costal vein almost to the lower angle, and over the hindwing from the upper subcostal to the submedian vein; cilia dark, lobe with a marginal white line, tails edged and tipped with white. Below pearl grey, the apex of the forewing widely, and the costa slenderly light fulvous brown, both wings with a double reddish streak across the end of the cell, and a slender, straight, brighter fulvous, transverse discal fascia, very slenderly bordered with blackish and whitish lines. On the forewing this is nearly straight, unbroken, on the hindwing it is dislocated inwardly below the upper median, and again below the lower median. Forewing with an obscure darker submarginal line, cilia dark. Hindwing mostly grey, the apex slightly tinged with rufous, the lower and anal part whitish with two submarginal lunular bands, a large black spot, edged anally with orange but without metallic scales, between the lower medians; lobe black edged with white, a slender black edge-line, cilia basally whitish, outwardly dark. Tails much as in *othona*, the anal one longest.

A single male, Mergui. The species somewhat resembles *Zeltus etolus*, though easily distinguished by the short tails and the absence of the blue reflections above. It has still more resemblance to *Sinthusa amba*. On account of the closely appressed costal and first subcostal veins, I place it in *Chliaria*, though its long narrow wings give it quite a different aspect.

48. *TAJURIA JANGALA*, Horsf.

Mergui, Myitta.

49. *DRINA DONINA*, Hew.

Mergui, Myitta, males only.

50. *DACALANA VIDUA*, Horsf.

Mergui. The specimens resemble those from the Malay Peninsula in all respects. As there seems to be some uncertainty about Horsfield's type, I have not substituted Mr. de Nicéville's name *Arrhenothrix* for *Dacalana*.

51. *THAMALA MARCIANA*, Hew. (*miniata*).

Mergui.

52. *HORAGA ONYX*, Moore.

Mergui. My specimens differ from Sikkim ones only in the ground colour of the underside, which is greenish yellow instead of ochreous brown. Only females taken.

53. *APHNÆUS LOHITA*, Horsf.

Mergui, Myitta.

54. *CURETIS MALAYICA*, Feld.

My specimens are very inconstant, as is usually the case in this genus.

Subfamily DEUDORIGINÆ.

Genus *ARAOTES*, nov.

55. *ARAOTES LAPITHIS*, Moore.

Mergui, Myitta, scarce.

56. *DEUDORIX EPIARBAS*, Moore, (*epijarbas*).

Myitta.

57. *RAPALA SUFFUSA*, Moore.

Mergui.

58. *RAPALA SCHISTACEA*, Moore.

Mergui. An abnormal female was taken with the transverse discal band below wholly obsolete on both wings.

59. *RAPALA SPHINX*, Fab.

Two males, Myitta. The male of this species sometimes has and sometimes has not a large black patch of metamorphosed scales on the forewing above.

Subfamily PORITINÆ.

Genus *PORITIA*.

In this genus the upper radial of the forewing originates at the end of the cell, so that there is a very short upper discocellular. The middle discocellular is upright and very slender, the lower obsolescent.

In the hindwing the discocellulars are also very slender, the upper rather long; the second bifurcation of the median vein is opposite the end of the cell. The apex of the forewing is rather rounded, the upper part of the outer margin being strongly rounded. The markings of the underside are annular and exceedingly variable. The sex-mark at the base of the hindwing of the male is a conspicuous tuft of black hairs on a dark ground. The hindwing of the female is less angled outwardly than in *Massaga*.

60. *PORITIA PHRAATICA*, Hew.

Mergui, common. My females have the ochreous areas small, even less than in Mr. Distant's figure. Mr. de Nicéville has one from the Malay Peninsula in which the hindwing is more than half ochreous. The male is very variable, but I have no specimen so green, or with so large and solid a coloured area as in Mr. Distant's figure. There is in all my specimens a triangular dark patch below the cell and a macular blue band across the apex.

61. *PORITIA HEWITSONII*, Moore, var. *TAVOYANA*, nov.

Myitta, Tavoy, common. The males are remarkably variable; many are wholly indistinguishable from those of *phraatica*. I have taken every variation from those resembling Mr. Distant's figure of *phraatica*, to those with an irregular blue area below the cell, wholly separate from a long submedian streak and a solid oblique subapical band. The underside varies greatly and does not differ from that of *phraatica*. The female is pale blue over fully a third of the forewing, and has more resemblance to the male than to the northern female with its small blue area. In the Tavoy form this extends from the cell to the hind margin, projecting in the interno-median space within an eighth of the outer margin; there is a blue spot in the cell and a variable subapical band sometimes obsolete. The blue area on the hindwing is variable but usually considerable. The ochreous discal spot of the forewing is occasionally present, though obscure.

Genus *MASSAGA*, nov.

I described this genus in 1886, the type being *M. clorinda*, which now turns out to be the male of *Poritia potina*, Hewitson. Lately, being dubious of its generic value, I asked Mr. de Nicéville to omit it in his "Butterflies of India," which he accordingly did. Subsequent examination and the discovery of the female have reassured me as to its distinctness.

In the forewing the upper radial originates a little beyond the cell, so that there is no trace of an upper discocellular vein; the middle discocellular is rather stout and oblique, the lower distinct, sinuous. In

the hindwing, the cell is longer than in *Poritia*, the upper discocellular short, very oblique, the lower long. The second forking of the median vein is considerably before the end of the cell. On the underside the ring-markings of *Poritia* are replaced by simple transverse lines. The apex of the forewing is more pointed, and is usually slightly falcate in both sexes, the upper part of the outer margin being slightly excised. The tuft of the male is inconspicuous in itself, but placed on a conspicuous ochreous patch. The hindwing of the female is conspicuously angled. The sexes are exceedingly unlike. The species are all very rare.

This genus is close to *Deramas* and *Zarona*, which it greatly resembles, but differs in having one subcostal vein less.

62. *MASSAGA PEDIADA*, Hew., Pl. XXIII, Fig. 15.

Male, above, velvety black; forewing with the following markings rich bluish-green, varying according to the light, namely, one below the cell, clavate, one basal below the internal vein, its terminal part crossing the vein, one a little beyond the cell, oblique, consisting of three quadrate spots, a submarginal row of six spots, the last larger, subcordate. *Hindwing* with a longitudinal mark in the interno-median space from the base, united terminally with the inner of a row of three triangular spots crossing the disc; three submarginal spots in the same spaces as the discal ones, the middle small, lunular, the outer two semi-circular, enclosing black spots, the subanal one largest. *Below* dull rufous brown with a pale violet gloss; forewing with a broken macular line of minute whitish spots across the disc, an outer-discal line of small and very obscure pale lunules, beyond which lies a pale band, the margin brighter rufous. *Hindwing*, base and costa dull rufous brown, most of the rest irrorated with whitish scales, an obscure darker transverse line with two sagittate marks on the median spaces, a submarginal dark zigzag line bordered inwardly by a pale line, a marginal bright reddish line bordered inwardly by slender black and white lines which do not extend to the apex.

Female, above blackish, cilia and costa paler. *Below* rufous brown, much lighter than in the male, a darker rufous streak across the end of the cell of both wings, a similar slender transverse discal fascia, continuous on the forewing, broken and lunular on the hindwing, a darker outer-discal line, obscure on the forewing, blackish subanally on the hindwing, placed in a paler band beyond a darker rufous one; some submarginal blackish scales near the anal angle of the hindwing, the margin of the forewing brighter rufous, hindwing with a brighter rufous marginal line bordered inwardly by slender black and white lines subanally.

63. *MASSAGA POTINA*, Hew. (? = *Simiskina fulgens*, Distant), Pl. XXIII, Fig. 3.

Male, above velvety black with the following rich blue markings varying according to the light, one below the cell, clavate, extending widely into the median spaces, one below the internal vein, with a spot above the end of it, a series of three spots a little beyond the end of the cell, the upper obscure, the lower quadrate; a submarginal series of six spots, the lower one large and cordate. *Hindwing* with a longitudinal mark in the interno-median space, from the base two-thirds to the outer margin, two discal spots in the next two spaces, three marginal crescents in these three spaces, the subanal one large with a streak outside of it beyond the submedian vein. *Below* rufous brown, brighter than in *pediada*; *forewing* with an obscure darker rufous streak across the end of the cell, a darker rufous line across the disc as far as the lower median, bordered outwardly by a darker bluish-tinged space, an outer-discal obscure lunular line, bordered inwardly by a paler bluish one and outwardly by a broad pale space, which is conspicuous and somewhat ochreous near the apex. Hind margin and interno-median space chiefly dull ochreous, shining; a bright reddish marginal line, cilia blackish. *Hindwing*, base and costa dark rufous-brown, the rest paler rufous, a brighter rufous streak closing the cell, a similar discal series of lunules irregularly placed, an obscure dark outer-discal lunular line obsolete subapically, bordered both inwardly and outwardly by a paler bluish space, and then by a brighter rufous one; a bright rufous marginal line bordered subanally by slender black and white ones, cilia dark.

Female, above bright orange-tawny, the apex and outer margin (not the costa) widely blackish, the ends of the three median and the internal veins brown or even orange, the orange area almost semicircular outwardly; the hind margin and the basal half of the interno-median space are always more or less irrorated with black scales, which also enter the base of the cell; a marginal rufous line, the cilia darker. *Hindwing* orange, generally strongly irrorated with black, the veins less so; an obscure submarginal band of darker quadrate spots; a rufous marginal line, the cilia darker. Some specimens have almost the whole upper surface orange, except the apex and margin of the forewing. *Below* light rufous brown, much paler than in the male, the markings darker ferruginous, resembling those of the male, but more distinct.

One male and five females (only one fresh), taken near Myitta, in the Tavoy district. The male differs from the male of *pediada* in having the markings larger, clearer, and not bluish-green, but blue. The underside is less dark and uniform. Both sexes are more falcate

than in *pediada*, and of larger size. The female generally sits on a leaf with half-open wings, and might easily be taken for a small *Cirrhochroa*, or sometimes for a *Loxura*. In any case its entire departure from the usual colours of the group indicates that it is likely to prove a mimic.

The female is somewhat variable. I have no doubt that it will turn out conspecific with *Poritia potina*,—from the Malay Peninsula—which I only know from Hewitson's figure.

It seems also probable that the insect named by Mr. Distant *Simiskina fulgens* and placed by him in the *Erycinidæ*, is identical\* with or at least very closely allied to this species. Unfortunately, he gives no description of the genus, merely noting two particulars in which, it is true, it differs from all Eastern *Erycinidæ*, but agrees with the *Poritias* and with most other genera of the *Lycenidæ*. The figure faithfully represents a rather worn and faded female of this species.

The egg differs from that of *Poritia* in having the hexagonal reticulations very regular and delicate; it has the same extraordinary shape. It differs wholly from the eggs of the Eastern *Nemeobiadæ*, which are all round in horizontal section and without the slightest trace of reticulation.

### Subfamily LYCÆNINÆ.

*Genus of uncertain position.*

64. CATOPCEILMA ELEGANS, Druce.

Mergui, Myitta.

### *Lycæna Group.*

65. CATOCHRYSOPS STRABO, Fab.

Mergui, Myitta.

66. CATOCHRYSOPS PANDAVA, Horsf.

Mergui.

67. CATOCHRYSOPS CNEIUS, Fab.

Mergui.

68. NACADUBA ARDATES, Moore.

Mergui, Myitta.

69. NACADUBA ATRATA, Horsf.

Myitta.

70. NACADUBA PAVANA, Horsf.

Myitta. Like *macrophthalmæ*, but with the lines of the underside slender and distinct, the basal ones absent.

\* Mr. Distant has since informed me that this is not the case.

71. *NACADUBA VIOLEA*, Horsf.

Mergui, Myitta.

72. *NACADUBA DANA*, de Nice, (? = *almora*, Drace).

Myitta.

73. *LAMPIDES ALIANUS*, Fab.

Mergui, Myitta.

74. *LAMPIDES SUBDITA*, Moore.

Mergui, Myitta.

75. *LAMPIDES BOCHUS*, Cram.

I am not aware of any difference between *Jamides* and *Lampides*, and think it likely that the former genus will have to fall before the latter, which occurs earlier in Hübner. It is to be hoped that no more species of this genus will be described without an examination of the *prehensores*, which are fortunately of great diversity in the different kinds, as if to counterbalance their puzzling similarity in colours and markings.

76. *POLYOMMATUS BATICUS*, Linnæus.

Myitta.

77. *TARUCUS PLINIUS*, Fab.

Mergui.

78. *EVERES UMBRIEL*, n. sp., Pl. XXIII, Fig. 1.

Male, above black, the cilia of the hindwing and of the lower angle of the forewing whitish, except at the ends of the veins. *Below* grey-white (much whiter than in *E. kala*) with the following blackish markings, the discal ones quadrate. *Forewing* with a streak across the end of the cell, a broad straight transverse discal band, inwardly dislocated below the middle median, the lower part outwardly oblique, outer margin widely dark, containing an inner lunular and an outer slender whitish fascia. *Hindwing* with a large subcostal, a smaller cellular and a minute abdominal spot all near the base, a streak across the end of the cell, and a broad discal transverse band broken into four quadrate masses of which only the upper two touch each other, the first covering two spaces, the second (strongly dislocated outwardly) three, and the third (nearer the base, oblique), two; the fourth being a small lunule between the submedian and the internal veins. Outer margin broadly dark, containing a row of whitish lunules (the subanal one orange) surrounding black spots of which the two subanal ones are touched with metallic green. A whitish submarginal and a black marginal line, both very slender, the cilia and the tip of the tail white.

The broad, unbroken, quadrate discal bands of the underside easily distinguish this peculiar species from *Everes kala*, de Nicéville, which has rows of round black spots instead. *E. kala* has somewhat the aspect



of a *Zizera* and *E. umbriel* that of a *Catochrysops*. Both species may turn out to be mimics. Since the above was written I have taken *kala* in the Naga Hills from 5,000 to 10,000 feet, along with species mostly Palearctic, while *umbriel* is a purely tropical species, apparently not infrequent in Tenasserim. The type specimen of *kala* is in my opinion a male, so that these two species have wholly lost the usual blue colour of their allies, in this resembling *Everes nyseus*. That species, which seems also to occur near Myitta (though I did not capture any), differs slightly from the typical *Everes* in having the discocellular veins of both wings meeting at a perceptible angle, but it seems scarcely worth while to retain the genus (*Talicada*) which has been founded on it. I took two males of *umbriel* in the Tenasserim Valley, and observed one or two others.

79. *EVERES PARRHASIUS*, Fab.

Mergui.

80. *EVERES PUTLI*, Kollar.

Mergui, Myitta. These two species are wide-ranging. I have taken both in the islands of Sumba and Sambawa, east of Java.

81. *ZIZERA PYGMÆA*, Snell.

Mergui. This also occurs in Sumba and Sambawa.

82. *ZIZERA SANGRA*, Moore.

Mergui, Myitta.

83. *CASTALIUS ROXUS*, Godt.

Mergui, Myitta. In this as well as in the preceding genus, the eyes are but slightly hairy.

84. *CASTALIUS ETHION*, Doub.

Mergui, Myitta.

85. *CASTALIUS ROSIMON*, Fab.

Mergui, Myitta.

86. *CYANIRIS TRANSPECTA*, Moore.

Myitta. I am not sure that this species is distinct from *puspa*.

87. *CYANIRIS PLACIDA*, de Nice.

Myitta.

88. *CYANIRIS MELÆNA*, n. sp., Pl. XXIII, Fig. 13.

Male, above, dark dull blue, resplendent in some lights, the blue extending over less than half the surface of the forewing, sometimes extending above the upper radial vein beyond the cell, the black area very large occupying the upper part of the cell, widening at the lower angle, and extending over more than a third of the hind margin. On the hindwing the blue occupies hardly more than a third of the surface, and does not approach either the costal or abdominal margin. There is no whitish patch on the upper surface. Cilia whitish. Below grey-white.

with a slight silvery lustre. *Forewing* with a streak across the end of the cell and a curved discal line of six dark streaks set in paler rings, the second, third, fourth and fifth outwardly oblique, the fifth and sixth removed inwardly : a submarginal row of joined ocellus-like spots, consisting of a dark lunule enclosing a pale, dark-pupilled spot, a marginal dark line. *Hindwing* with three distinct basal spots, a streak across the end of the cell, a very irregular series of discal spots, the first very large and black, near the costa, the second minute, near the first but more basal, the next four forming an oblique crescent (the fifth small, the sixth larger, nearer the base), the seventh large, removed outwardly, the eighth (between the submedian and the internal veins) smaller and nearer the base. The submarginal ocelli are as in the forewing, the inner lunular line more serrate. Female unknown.

This species, which is the darkest *Cyaniris* known, was taken in the Tenasserim Valley in February, but in the rains it is perhaps confined to higher lands. An apparently identical species is found in the Malay Peninsula at a considerable height, and seems to be *C. jyntheana*, Distant (*nec de Nicéville*).

The genus *Cyaniris* is better represented in the tropics than is generally supposed. I have myself taken ten species, including *haraldus*, in the Malay Peninsula, eight confined to high elevations ; also, seven in the mountains of Eastern Java and four in the Celebes, besides *C. duponchelii*, Godt. (?=*puspa*, Mopre) in Sumba and Sambawa, and *C. akasa* in Sambawa at 4,500 feet elevation.

#### *Pithecopus Group.*

89. NEOPITHECOPS ZALMORA, Butler.

Mergui, Myitta, commoner than *P. hylax*. The species occurs in Java and Sumba, but is rare in both. It is common from the Chittagong Hill Tracts to South-Eastern Borneo.

90. PITHECOPS HYLAX, Fab.

Myitta, Mergui, scarce.

91. MEGISBA MALAYA, Horsf.

Myitta, Mergui. The species occurs unchanged in Borneo, Java, Sumba, and Sambawa. Not being protected like the two preceding genera, it has acquired narrower and more pointed wings, and a much swifter flight.

#### *Genera of Uncertain Position.*

92. NIPHANDA CYMBIA, de Nice.

One male, Myitta. I have taken the allied *N. tessellata* in Province Wellesley, and the Kedah State, Malay Peninsula, where it is very rare.

93. *LYCENÆSTHES LYCENINA*, Feld.

Mergui, Myitta.

94. *LYCENÆSTHES BENGALENSIS*, Moore.

Mergui, Myitta.

95. *SPALGIS EPIUS*, West.

Mergui, differing slightly from Indian specimens, the discal white patch on the forewing below conspicuous. The genus is found everywhere from the Himalayas to Amboyna (occurring in all the islands east of Java), and the species, if there are more than one, are very hard to make out. They live in the drier districts only, the larva apparently feeding on acacias.

96. *TARAKA HAMADA*, Druce.

Myitta. I have also taken it in Eastern Java at 4-5000 feet elevation.

Subfamily GERYDINÆ.

Genus MALAIS, nov.

Differs from *Logania* in the short, thick, slightly flattened legs, the tibiæ being thickest in the middle.

97. *MALAIS SRIWA*, Distant.

One female (Mergui) is obviously of this species. It is possibly distinct from *L. marmorata*, Moore, but the bad state of the types of that species makes its difficult to decide. I postpone a fuller description of the genus.

Of this genus another species occurs at Bassein, Burma; it is one of the smallest and obscurest of Indian butterflies. *Logania malayica* seems rare in the Malay Peninsula (where a number of allied forms occur), but it is rather common in South-Eastern Borneo. The genus is also represented in the Celebes. *Logania andersonii*, Moore, from Mergui, which is probably the *Hypolycaena libna* of Hewitson, is apparently not related to the *Gerydinae*, though the wretched state of the sole type makes it difficult to say where it does belong. The venation is extraordinary. There are only three subcostal branches (according to Mr. de Nicéville's phraseology two nervules besides the nervure), the first of which is united with the costal vein for a very short distance.

98. *ALLOTINUS NIVALIS*, Druce, (*Paragerydus nivalis*, Distant; *Logania substrigosa*, Moore).

This species must be placed in *Allotinus*, the third subcostal branch being emitted immediately before the end of the cell, leaving a short but distinct upper discocellular vein, as required by Felder's definition of the genus.

If *substrigosa* be distinct from *nivalis*, my specimens from Mergui and Myitta must be called by that name. But I believe that the two are merely extreme forms of a single species, in which the size and distinctness of the markings of the underside vary greatly. It is a common species from Tavoy to South-Eastern Borneo, and obviously mimics *Neopithecops zalmora*, Butler, from which it is indistinguishable when flying.

99. ALLOTINUS ALKAMAH, Distant.

This species represents the Javanese *A. subviolaceus*, Felder, from Mergui to South-Eastern Borneo. The sexes are much alike. In my Tenasserim females the disc of the hindwing is largely covered with bluish scales.

In some specimens of *Allotinus drumila* the third subcostal originates slightly before the end of the cell, leaving the upper discocellular very distinct, while in others it originates after the end of the cell and there is no upper discocellular just as in *Paragerydus taras*. It is also remarkable for the very irregular outline of the wings. This feature is lacking in *Allotinus multistrigatus*, in which the subcostal originates opposite the end of the cell, the upper discocellular being therefore minute.

100. PARAGERYDUS HORSFIELDII, Moore, (*Allotinus aphocha*, Kheil).

This is the commonest of the *Gerydinae* from the Chittagong Hill Tracts to South-Eastern Borneo, found in great numbers wherever there is deep shade. I am inclined to think that this species (and not *taras* with its conspicuous reddish apex and margin) is the *Allotinus unicolor* of Felder, but without examining the types of that species it is impossible to decide.

The cell in this species ends halfway\* between the bases of the second and third subcostals, which in the male are approximate. On this character the genus *Paragerydus* has been formed, but it is improbable that it can be retained distinct from *Allotinus*. The following species seems to be structurally halfway between the two.

101. PARAGERYDUS TARAS, n. sp., Pl. XXIII, Fig. 10.

Above, dark brown, deepest apically on the forewing, lacking both the elongate discal band of the male, and the pale discal area of the female of *P. horsfieldii*. Below the ground is creamy whitish (dull bluish grey in *P. horsfieldii*, the stræ less numerous, especially discally and basally, and less evenly distributed; the apex of the forewing is widely tinged with rufous brown, the cilia rather long and also rufous brown; a rufous brown marginal line; the transverse macular discal band is

\* In the female. In some males it is nearer the base of the second.

nearly as obvious as in *P. horsfieldii*, but is composed of slender, crescent-shaped markings, beyond which is a submarginal line of blackish dots, of which the subapical ones on the forewing, situated in the brown area, are touched outwardly with white.

In the male the forewing is longer and more acute than in *P. horsfieldii*, its outer margin but little curved, while in the female its upper portion is strongly convex. In the hindwing the degree of marginal undulation varies greatly, as is also the case with *horsfieldii*. The female is paler than the male and while flying has almost the air of a white butterfly.

The preensores obviously differ from those of *horsfieldii*, the tips of the unci (*tegumina*) being rounded and but slightly oblique, while in *P. horsfieldii* they are very oblique and regularly tapering. As seen from the side, the clasps (*harpagones*) end in two processes separated by a deep sinus, the upper longest, and ending in a strong hook directed upwards. In *P. horsfieldii* the upper process is obsolescent, represented only by an angle in the upper contour of the other.

The types are from the Tenasserim Valley, east of Tavoy, Burma. I have also taken it in the Chittagong Hill Tracts. An apparently identical form occurs in the Malay Peninsula and South-Eastern Borneo, but I have no specimens now available for comparison.

The venation of this species is interesting. The origin of the third subcostal vein is immediately beyond the end of the cell, so that, as in *Paragerydus horsfieldii*, there is no upper discocellular vein. In the male, the second and third subcostal veins are remarkably approximate throughout, and the bifurcation of the latter is nearer the end of the cell than the apex of the wing. In this it resembles *Allotinus alkamah*.

102. *GERYDUS ANCON*, n. sp., Pl. XXIII, Fig. 8.

*Male, above*, forewing with the apex and outer margin black, and the base (as well as the hindwing) dull fuscous leaving about two-fifths of its area pure white. A white band extends obliquely from the costa one-fourth from the base, widening to the middle median vein two-thirds from the base, where it touches another white area extending from the middle median vein to the hind margin, of which it occupies the middle two-thirds, filling likewise nearly two-thirds of the interno-median space, and extending, except at its excised lower angle, within one-eighth of the outer margin, leaving the basal third of the interno-median space fuscous, and almost enclosing, with the superior band, an elongate black area occupying the basal part of the lower median space and united with the fuscous basal area. The upper median vein is swollen where it crosses the white band, from just beyond its origin one-fourth towards its termination. *Below* light rufous brown, the

white areas of the upperside reduced in size and set in a wide blackish area, a marginal dark line on the forewing, and a series of obscure dark submarginal dots on both wings. *Hindwing* with obscure mottlings of slightly different shades of pale brown; three of these between the costal and subcostal veins are bordered by transverse blackish lines; an irregular blackish fascia extends obliquely across the disc from the submedian space to the radial vein.

My single female lacks of course the swelling of the upper median vein. The hindwing is slightly angled in the middle. The lower white area of the forewing is much smaller, being narrow and oblique, occupying only one-third of the hind margin, bent inwardly just above the internal vein, its terminal quadrate portion (between the middle median vein and the middle of the interno-median space) being dehiscent outwardly along the line of the lower median vein. The underside is paler, less reddish and more variegated than in the male, with the markings very irregular. Expanse  $2\frac{1}{2}$  inches.

Two males and a female, from the Tenasserim Valley, Tavoy district.  
103. GERYDUS CROTON, n. sp., Pl. XXIII, Fig. 9.

*Male, above*, dark brown, the apical part of the forewing black, an obscure fuliginous whitish band extending obliquely from beyond the end of the cell to the middle median vein two-thirds from its origin, two obscure whitish spots beyond and below it, one on each side of the lower median vein, the lower sometimes obsolete. *Below* very dark, variegated with many shades of brown; the band is dull ochreous, broad and well marked, the upper of the two spots is large and but slightly separated from it, the lower very small, oblique and distinct, there are some costal markings, a subapical cordate spot, and three submarginal blackish dots. The *hindwing* has the basal half very dark with some paler brown transverse markings edged with dark, a blackish semicircular band with a slight bluish gloss extending across the wing beyond the cell, after which comes a semicircle of joined cordate reddish-brown maculae, beyond which the ground is again dark, with a light brown marginal band near the apex.

*Female, upperside*. The band is more distinct and nearly white, extending obliquely almost to the costa and to the middle median vein two-thirds from its origin, the upper of the two spots separated from it only by the vein, the lower smaller and more isolated. *Below* much lighter and more variegated than the male, the dark submarginal dots forming a complete series on the forewing, the outer part of the hindwing pale brown, except a large sordid area centring round the upper median vein. Expanse over two inches,

The lower angle of the forewing is in this species somewhat less produced inferiorly than in *G. ancon*, the hindwing of the female somewhat

more angled in the middle, the upper median vein of the forewing of the male is not swollen. The prehensors differ but slightly.

Three males and a female taken in the Tenasserim Valley. Like the preceding species it has a strong irregular flight (quite different from the feeble uncertain motions of the *Paragerydi* and *Loganias*), wheeling many times round the same circle, or up and down a certain length of the path, and would be difficult to catch but for its habit of returning again and again to the same leaf.

104. *GERYDUS BOISDUVALII*, Moore.

One female from the Tenasserim Valley, Tavoy district.

105. *GERYDUS BIGGSII*, Distant.

One female, Tenasserim Valley. These four species of *Gerydus* differ somewhat in the length of the cell which increases in the following order—*croton*, *ancon*, *boisduvalii*, *biggsii*. In the first, the end of the cell is immediately beyond the origin of the second subcostal, in the last halfway between those of the second and third, as in *Paragerydus*.

Another female *Gerydus* from the Tenasserim Valley resembles *G. biggsii*, but the white of the forewing occupies the whole disc and two-thirds of the cell, just reaching the hind margin and covering nearly half the area of the wing. The hindwing is all brown, and the underside much as in *biggsii*.

#### Subfamily LIPHYRINÆ.

I saw what I supposed to be a male of this species, near Myitta, flying slowly in the twilight. Having no net with me, I lost it. The species of *Allotinus* are also often seen flying almost till dark.

#### EXPLANATION OF PLATE XXIII.

- Fig. 1 *Everes umbræi*, n. sp., ♂, p. 433.  
 „ 2 *Chliaria mergua*, n. sp., ♂, p. 427.  
 „ 3 *Massaga potina*, Hew, ♂, p. 431.  
 „ 4 *Surendra florimel*, n. sp., ♀, p. 424.  
 „ 5 *Flos artegai*, n. sp., ♂, p. 423.  
 „ 6 *Arhopala duessa*, n. sp., ♂, p. 419.  
 „ 7 *Arhopala hellenore*, n. sp., ♂, p. 422.  
 „ 8 *Gerydus ancon*, n. sp., ♂, p. 438.  
 „ 9 *Gerydus croton*, n. sp., ♂, p. 439.  
 „ 10 *Paragerydus taras*, n. sp., ♂, p. 437.  
 „ 11 *Arhopala perissa*, n. sp., ♂, p. 419.  
 „ 12 *Arhopala pastorella*, n. sp., ♂, p. 418.  
 „ 13 *Cyaniris melæna*, n. sp., ♂, p. 434.  
 „ 14 *Biduanda scudderi*, n. sp., ♂, p. 426.  
 „ 15 *Massaga pediada*, Hewitson, ♂, p. 430.  
 „ 16 *Biduanda nupvillet*, n. sp., ♂, p. 426.  
 „ 17 *Surendra florimel*, n. sp., ♂, p. 424.  
 „ 18 *Arhopala belphæbe*, n. sp., ♂, p. 421.

XXIV.—Index to the first five Papers on Indian Rhynchota, completing the Family Pentatomidæ :—I, Journ. lvi, Pt. ii, p. 22, 1887: II, *ib.*, p. 144: III, *ib.*, lvii, p. 1, 1888: IV, *ib.*, p. 118: V, *ib.*, lviii, 20, 1888.—By E. T. ATKINSON, B. A.

- A.  
 ABREONA, lvii, p. 146.  
   gladiatoria, 146.  
   serrata, 146.  
 ACANTHIA.  
   *histeroides*, lviii, 104.  
 ACANTHOSOMINA, lviii, p. 20.  
 ACANTHOSOMA, lviii, p. 21.  
   *alaticornis*, 26.  
   *aspera*, 25.  
   *binotata*, 25.  
   *cornutum*, 31.  
   *difficilis*, 23.  
   *distincta*, 22.  
   *dubia*, 23.  
   *elongata*, 24.  
   *forfex*, 24.  
   *hamata*, lvii, 150.  
   *heterospila*, lviii, 29.  
   *immunda*, 26.  
   *laevicornis*, 23.  
   *lencatum*, 28.  
   *megacephalum*, 21.  
   *nigricornis*, 27.  
   *proxima*, 22.  
   *punctatum*, 36.  
   *recurrum*, 35.  
   *rufescens*, 30.  
   *truncatula*, 26.  
   *uniguttatum*, 28.  
 ACATALECTUS, lvi, p. 45.  
   *clarus*, 46.  
   *magnus*, 45.  
 ACESINES, lvii, p. 131.  
   *breviceps*, 132.  
 ACROSTERNUM, lvii, p. 118.  
   *gramineum*, 118.  
 ADRIA, lvii, p. 34.  
   *parvula*, 34.  
 ADRIA, lvi, p. 45.  
   *clara*, 46.  
   *magna*, 45.  
 AEDNUS, lvii, p. 14.  
   *obscurus*, 14.  
   *similis*, 14.  
   *ventralis*, 15.  
 AELIA.  
   *crucifera*, lvii, p. 48.  
   *depressa*, 31.  
   *furcata*, lviii, 104.  
   *glandulosa*, 98.  
   *histeroides*, 104.  
   *nubila*, lvii, 48.  
   *rostrata*, lviii, 107.  
 AELIOMORPHA, lvii, p.  
   *lineaticollis*, 37.  
 AESCHRUS, lvii, p. 35.  
   *obscurus*, 36.  
   *tuberculatus*, 36.  
 AESCHROCORIS, lvii, p. 35.  
   *obscurus*, 36.  
   *tuberculatus*, 36.  
 AETHUS, lvi, p. 46.  
   *badius*, 54.  
   *borrei*, 47.  
   *brevipennis*, 59.  
   *brunneus*, 54.  
   *elongatus*, 56.  
   *foveolus*, 53.  
   *impressicollis*, 47.  
   *indicus*, 47.  
   *maurus*, 49.  
   *opacus*, 54.  
   *palliditarsus*, 56.  
   *perosus*, 47.  
   *perpunctatus*, 48.  
   *pygmaeus*, 55.  
   *varians*, 50.  
 AGAEUS, lvii, p. 49.  
   *mimus*, 51.  
   *tessellatus*, 50.  
 AGATHOCLES, lvii, p. 152.  
   *limbatus*, 153.  
 AGONOSCELIS, lvii, p. 48.  
   *femorals*, 48.  
   *indica*, 48.  
   *nubila*, 48.  
 ALCIMUS, lvii, p. 66.  
   *coronatus*, 67.  
   *flavicornis*, 68.  
 ALPHOCORIS, lvi, p. 186  
   *lixoides*, 187.  
 AMACOSIA.  
 AMASENUS, lvii, p. 160.  
   *corticalis*, 160.  
 AMAUROPEPLA, lvi, p. 198.  
   *denticulata*, 198.  
 AMAURUS.  
   *brevicornis*, lviii, 92.  
   *cupreus*, 93.  
   *ineimis*, 93.  
 AMBIORIX, lvii, p. 144.  
   *senescens*, 144.  
 AMISSUS, lviii, p. 62.  
   *Atlas*, 63.  
 AMYNTOR, lvii, p. 153.  
   *obscurus*, 154.  
 AMYOTEA.  
   *dystercoides*, lvii, p. 182.  
   *nigripes*, 182.  
 ANALOCUS.  
   *misellus*, lvii, p. 42.  
 ANAXANDRA, lviii, p. 30.  
   *compacta*, 34.  
   *cornuta*, 31.  
   *fulvicornis*, 33.  
   *hamata*, 34.  
   *nigrocornuta*, 32.  
   *nigrolineata*, 32.  
   *rufescens*, 30.  
   *sigillata*, 32.  
   *tauriformis*, 33.  
 ANTESTIA, lvii, p. 135.  
   *anchora*, 135.  
   *apicalis*, 166.  
   *cruciata*, 137.  
   *flavovaria*, 140.  
   *historio*, 142.  
   *modificata*, 138.  
   *pulchra*, 136.  
   *varipennis*, 141.  
 APINES, lvii, p. 138.  
   *concinna*, 139.  
 APODIPHUS, lvii, p. 4.  
   *amygdali*, 4.  
   *hellenicus*, 5.  
 APODIPHYA, lvii, p. 4.  
   *amygdali*, 5.  
   *hellenica*, 5.  
 APTOCORIS, lvi, p. 169.



- incisus, 189.  
**ARMA.**  
   *geometrica*, lvii, p. 177.  
   *lurida*, 181.  
   *spinidens*, 177.  
   *turbida*, 188.  
   *velata*, 182.  
**ASIARCHA**, lviii, p. 72.  
   *nigridorsis*, 72.  
**ASOPINA**, lvii, p. 169.  
**ASOPUS**, lvii, p. 181.  
   *argus*, 182.  
   *armiger*, 175.  
   *chiropterus*, 178.  
   *coeruleus*, 169.  
   *dystercoides*, 182.  
   *geometricus*, 177.  
   *luridus*, 181.  
   *mactans*, 182.  
   *malabaricus*, 182.  
   *nigripes*, 182.  
   *ulceratus*, 178.  
   *verrucifer*, 172.  
**ASPIDESTROPHUS**, lvi, p. 200.  
   *lineola*, 200.  
   *morio*, 200.  
**ASPONGOPUS**, lviii, p. 87.  
   *alternans*, 85.  
   *amethystinus*, 75.  
   *brunneus*, 87.  
   *circumcinctus*, 91.  
   *depressicornis*, 85.  
   *fuscus*, 90.  
   *janus*, 88.  
   *marginalis*, 90.  
   *nepalensis*, 90.  
   *nigriventris*, 89.  
   *nigroaeneus*, 91.  
   *obscurus*, 88.  
   *ochreus*, 89.  
   *sanguinolentus*, 89.  
   *siccifolius*, 89.  
   *unicolor*, 90.  
   *vicinus*, 88.  
**ASTYANAX**, lvii, p. 129.  
   *trimaculatus*, 130.  
**ASTLA**, lvii, p. 164.  
   *indioatrix*, 165.  
**ATELIDES**, lviii, p. 94.  
   *centrolineatus*, 94.  
**ATELOCERA**, lviii, p. 102.  
   *furcatus*, 102.  
**AUDINETIA**, lvii, p. 176.  
   *aculeata*, 177.  
   *spinidens*, 177.  
**AXIAGASTUS**, lvii, p. 128.  
   *rosmarus*, 129.  
  
**B.**  
**BAGRADA**, lvii, p. 58.  
   *piota*, 58.  
  
**BASICRYPTUS**, lviii, p. 99.  
   *illuminatus*, 99.  
**BATHYCOEIA.**  
   *indica*, lvii, p. 145.  
**BELLOCORIS**, lvi, p. 187.  
**BELOPIS**, lvii, p. 9.  
   *unicolor*, 9.  
**BESSIDA**, lvii, p. 84.  
   *scutellaris*, 84.  
**BLACHIA**, lvii, p. 171.  
   *ducalis*, 171.  
**BOLACA**, lvii, p. 69.  
   *unicolor*, p. 70.  
**BRACHYAULAX**, lvi, p. 168.  
   *oblonga*, 164.  
**BRACHYPELTA**, lvi, p. 49.  
   *aterrimus*, 50.  
   *elevata*, 50.  
   *tristis*, 50.  
**BRACHYPLATY'S** lvi, p. 26.  
   *adjuncta*, 30.  
   *bistriga*, 29.  
   *burmeisteri*, 29.  
   *cognata*, 29.  
   *nitidus*, 29.  
   *radians*, 27.  
   *silphoides*, 28, 29.  
   *subaeneus*, 28.  
   *VahlII*, 27.  
  
**C.**  
**CAENINA**, lvi, p. 191.  
   *variolosa*, 191.\*  
**CALACTA**, lvi, p. 24.  
   *lugubris*, 35.  
   *rufo-notata*, 24.  
**CALLIDEA**, lvi, p. 166.  
   *abdominalis*, 181.  
   *baro*, 167.  
   *basilica*, 172.  
   *bengalensis*, 172.  
   *coelestis*, 178.  
   *contraria*, 191.  
   *cozalis*, 169.  
   *dilatocollis*, 181.  
   *dispar*, 149.  
   *distinguenda*, 167.  
   *dorsalis*, 179.  
   *eques*, 179.  
   *fascialis*, 189: lvii, p. 184  
   *formosa*, 179.  
   *gibbula*, 190.  
   *grandis*, 166.  
   *histeroides*, 190.  
   *lanius*, 163.  
   *lateralis*, 182.  
   *marginella*, 178.  
   *nobilis*, 165.  
   *ocellata*, 149.  
   *obtusa*, 183.  
   *ornata*, 176.  
   *patricia*, 172.  
   *porphyricola*, 176.  
   *pulchella*, 177.  
   *purpurea*, 174.  
   *Roylii*, 182.  
   *Schwaneeri*, 179.  
   *scripta*, 190.  
   *semmaculata*, 168.  
   *spinigera*, 183.  
   *Stockerus*, 172, 174, 181.  
   *StollII*, 175.  
   *sumatrana*, 181.  
**CALLIPHARA**, lvi, p. 161, 164.  
   *amethystina*, 163.  
   *baro*, 167.  
   *buquetii*, 165.  
   *dispar*, 149.  
   *grandis*, 166.  
   *Iris*, 168.  
   *nepalensis*, 163.  
   *nobilis*, Fabr., 162.  
   *nobilis*, Linn., 165.  
   *oblonga*, 164.  
   *obscura*, 165.  
**CALLIPREPES**, lviii, p. 47.  
   *Grayi*, 48.  
**CANTAO**, lvi, p. 149.  
   *dispar*, 149.  
   *ocellatus*, 149.  
   *rufipes*, 149.  
**CANTHECONA**, lvii, p. 173.  
   *binotata*, 174.  
   *furocellata*, lvii, p. 175.  
   *tibialis*, lvii, p. 174.  
**CAPPAEA**, lvii, p. 21.  
   *multilinea*, 22.  
   *taprobanensis*, 22.  
**CARBULA**, lvii, p. 43.  
   *biguttata*, 44.  
   *fusca*, 44.  
   *obscura*, 44.  
   *soutellata*, 45.  
**CARENOSCAPTUS**, lvii, p. 127.  
   *maculipes*, 127.  
**CARPOCORIS**, lvii, p. 29.  
   *baccarum*, 30.  
   *nigricornis*, 29, 183.  
**CATACANTHUS**, lvii, p. 70.  
   *aurantius*, 71.  
   *incarnatus*, 71.  
**CAZIRA**, lvii, p. 171.  
   *chiroptera*, 178.  
   *internexa*, 172.  
   *ulcerata*, lvii, p. 173.  
   *verrucosa*, 172, 178.  
**CEGYRINA**, lvii, p. 170.  
   *platyrhinoides*, 170.  
   *Cephaloctenus*, lvi, p. 37.  
**CEPHALOCYTEUS**, lvi, p. 37.  
   *melolonthoides*, 37.  
**CERATAULAX**, lvi, p. 201.

- CHILOCORIS**, lvi, p. 57.  
*nitidus*, 57.  
*parumpunctatus*, 58.  
*piceus*, 58.  
**CHYSOCORIS**, lvi, p. 166, 170.  
*andamanensis*, 171, 177.  
*atriventris*, 170, 171.  
*coxalis*, 169.  
*dilatocollis*, 171, 181.  
*elatus*, 170, 172.  
*eques*, 171, 179.  
*fascialis*, lvii, p. 184.  
*grandis*, lvi, p. 166.  
*hypomelaena*, 171.  
*Iris*, 168.  
*marginellus*, 171, 178.  
*ornatus*, 171, 176.  
*patricius*, 170, 172.  
*porphyricolus*, 171, 176.  
*pulchellus*, 171, 177.  
*purpureus*, 170, 174.  
*Stockerus*, 181.  
*Stolii*, 171, 175, 181.  
*viridis*, 170, 175.  
**CIMEX**,  
*ajer*, lviii, p. 88.  
*amethystinus*, 75.  
*anchora*, lvii, p. 185.  
*aterrimus*, lvi, p. 50.  
*aurantius*, lvii, p. 71.  
*baccarum*, 80, 81.  
*beryllus*, 125.  
*bicolor*, lvi, p. 60.  
*biguttatus*, lvii, p. 44.  
*binotatus*, 44.  
*bispinosus*, lvi, p. 194.  
*boutanicus*, lvii, p. 155.  
*brevipennis*, lvi, p. 59.  
*brevicorne*, lviii, p. 92.  
*brunneus*, 87.  
*cappata*, lvii, p. 183.  
*chinensis*, lviii, p. 56.  
*cinerea*, lvii, p. 188.  
*cinnamomeus*, 23.  
*clavatus*, lvi, p. 203.  
*coarctatus*, 195.  
*coeruleus*, lvii, p. 169.  
*cordiger*, 184.  
*corneus*, 188.  
*cribrarius*, 81.  
*cruciatu*, 187.  
*dama*, 160.  
*dentatus*, 7.  
*dispar*, lvi, p. 140.  
*dominulus*, lvii, p. 53.  
*Druriet*, lvi, p. 158.  
*elector*, lvii, p. 180.  
*eques*, lvi, p. 179.  
*erynys*, lvii, p. 29.  
*fallax*, 52.  
*fasciatus*, lvi, p. 162.  
*festivus*, lvii, p. 52, 53.  
*fimbriatus*, 124.  
*flavescens*, lvii, p. 148.  
*Frischii*, 183.  
*fullo*, 5.  
*furcellatus*, lvii, p. 175.  
*gastricus*, 14.  
*gramineus*, 118.  
*grandis*, lvi, p. 166.  
*guttatus*, lvii, p. 6.  
*guttigerus*, 39.  
*hamatus*, 150.  
*hemichloris*, 120.  
*histrio*, 142.  
*Hübneri*, 143.  
*humeralis*, 150.  
*incarnatus*, 71.  
*Janus*, lviii, p. 88.  
*javanicus*, 55.  
*limbatus*, lvii, p. 59.  
*luridus*, 180.  
*mactans*, 182.  
*malabaricus*, 182.  
*marmoreus*, 23.  
*maurus*, lvi, p. 188.  
*melanopus*, lvii, p. 71.  
*mucoreus*, 5.  
*niger*, lvi, p. 50.  
*nigricornis*, lvii, p. 29.  
*nigripes*, 71.  
*nobilis*, Linn., lvi, p. 165.  
*nobilis*, Fabr., 161.  
*nubilus*, lvii, p. 48.  
*obscurus*, lviii, p. 88.  
*ocellatus*, 149.  
*oculatus*, Fabr., lvi, p. 202.  
*oculatus*, Fabr., lvii, p. 182.  
*ornatus*, 54.  
*papillosus*, lviii, p. 56.  
*patricius*, lvi, p. 172.  
*pictus*, lvii, p. 58.  
*piceus*, 23.  
*prasinus*, 28.  
*purpureipennis*, 188.  
*pustulatus*, lvi, p. 165.  
*rubens*, lviii, p. 75.  
*rubrofasciatus*, lvii, p. 143.  
*Schranki*, 183.  
*seladonicus*, 118.  
*serratus*, 150.  
*silphoides*, lvi, p. 28.  
*sinensis*, lviii, p. 56.  
*smaragdulus*, lvii, p. 119.  
*spinidens*, 177.  
*spinipes*, lvi, p. 54.  
*spirans*, lvii, p. 120.  
*Stockerus*, lvi, p. 174.  
*Stolii*, 175.  
*sulcatus*, lvii, p. 7.  
*surinamensis*, lviii, p. 88.  
*taurus*, lvii, p. 159.  
*testudinaria*, 183.  
*torquatus*, 120.  
*tristis*, lvi, p. 50.  
*uniguttatus*, lviii, p. 28.  
*VahlII*, lvi, p. 27.  
*verbasci*, lvii, p. 81.  
*viridissimus*, Poda, 28.  
*viridissimus*, Wolff, 120.  
*viridulus*, 120.  
**CINXIA**, lvii, p. 59.  
*limbata*, 59.  
**CLINOCORIS**, lviii, p. 35.  
*cruciger*, 86.  
*maculatus*, 37.  
*punctatus*, 86.  
*recurvus*, 85.  
*scutellata*, 37.  
**CODOPHILA**, lvii, p. 32.  
*maculicollis*, 32.  
**COELOGLOSSA**, lvi, p. 146.  
**COENINA**, lvi, p. 191.  
*variolosa*, 191.  
**COLPOPROCTUS**, lviii, p. 87.  
**COMPASTES**, lvii, p. 154.  
*boutanicus*, 155.  
*spinosus*, 155.  
*truncatus*, 155.  
**CORTOSOMA**, lvi, p. 80.  
*assamensis*, 35.  
*atomarium*, 31.  
*brevis*, 35.  
*cicatricosa*, 34.  
*cincta*, 33.  
*cinctum*, 32, 33.  
*circumscripta*, 32.  
*cribraria*, 31.  
*duodecimpunctata*, 80.  
*fimbriata*, lvii, p. 10.  
*integra*, lvi, p. 35.  
*nepalensis*, 32.  
*pardalina*, 32.  
*parvula*, 34.  
*punctiventris*, 35.  
*sphaerula*, 33.  
*tigrina*, 35.  
*xanthochlora*, 34.  
**COSMOCORIS**, lvi, p. 166, 169.  
**CRATONOTUS**, lvii, p. 47.  
*coloratus*, p. 47.  
**CRESPHONTES**, lvii, p. 134.  
*nigro-maculatus*, 134.  
**CRESSONA**, lviii, p. 96.  
*valida*, 97.  
**CRITHEUS**, lvii, p. 180.  
*lineatifrons*, 131.  
**CUSPICONA**, lvi, p. 147.  
*antica*, 149.  
*curtispina*, 148.  
*plagiata*, 148.

- smaragdina, 149.  
 virescens, 148.  
 CYCLOPETA, lviii, p. 85.  
   obscura, 85.  
   siccifolia, 89.  
   tartarea, 86.  
   trimaculata, 86.  
 CYDNINA, lvi, p. 36.  
 CYDNUS, lvi, p. 46, 49.  
   apicalis, 55.  
   aterrimus, 50.  
   bicolor, 60.  
   brevipennis, 59.  
   brunneus, 54.  
   brunnipennis, 50.  
   carbonarius, 50.  
   cytomenoides, 60.  
   elongatus, 56.  
   indicus, 47.  
   laticeps, 52.  
   latipes, 39.  
   nigritus, 52.  
   nubilosa, 60.  
   oblongus, 56.  
   pallidicornis, 55.  
   proximus, 54.  
   rarcociliatus, 55.  
   sanguinicollis, 60.  
   spinipes, Schrk, 50.  
   spinipes, Fabr., 54.  
   tristis, 50.  
   varians, 50.  
  
 D.  
 DALCANTHA, lviii, p. 80.  
   dilatata, 81.  
   inermipes, 81.  
   regia, 81.  
   Sancti Fargavii, 77.  
   Servillei, 80.  
   Stålhi, 81.  
 DALPADA, lvi, p. 202.  
   affinis, 205.  
   alternans, 205.  
   angulicollis, lvii, p. 1.  
   apicifera, 4.  
   aspersa, lvi, p. 202.  
   brevis, lvii, p. 4.  
   brevivitta, 2.  
   bulvifera, 1.  
   cinotipes, 4.  
   clavata, lvi, p. 203.  
   concinna, 204.  
   confusa, lvii, p. 3.  
   consobrina, 4.  
   nigricollis, lvi, p. 204.  
   nodifera, lvii, p. 4.  
   obtusicollis, 26.  
   oculata, lvi, p. 202.  
   pilicornis, 203.  
   remota, lvii, p. 23.  
  
   tecta, 3.  
   triguttata, 1.  
   trimaculata, 1.  
   varia, lvi, p. 205.  
   versicolor, 203.  
 DALSIRA, lviii, p. 97.  
   glandulosa, 98.  
 DINIDORINA, lviii, p. 85.  
 DINIDOR, lviii, p. 85.  
   amethystinus, 76.  
   depressicornis, 85.  
 DIPLORHINUS, lviii, p. 101.  
   furcatus, 102.  
   quadricornis, 101.  
 DIPLOSTIRA, lvii, p. 127.  
   valida, 127.  
 DOLYCORIS, lvii, p. 30.  
   baccarum, 30, 31.  
   indicus, 32.  
   verbasci, 31.  
  
 E.  
 EDESSA.  
   amethystina, lviii, p. 75.  
   aurantia, lvii, p. 71.  
   brevicornis, lviii, p. 92.  
   dama, lvii, p. 160.  
   glandulosa, lviii, p. 98.  
   guttata, lvii, p. 6.  
   hamata, 150.  
   Janus, lviii, p. 88.  
   marmorea, lvii, p. 23.  
   nigripes, 71.  
   obscura, lviii, p. 88.  
   picus, lvii, p. 23.  
   rübens, lviii, p. 75.  
   taurus, lvii, p. 159.  
 ELASMOSTETHUS, lviii, p. 35.  
 ELASMUCHA, lviii, p. 35.  
   Spinollae, 135.  
 EMBOLOSTERNA, lviii, p. 52.  
   taurus, 53.  
 ERTHESSINA, lvii, p. 5.  
   acuminata, 7.  
   fullo, 5.  
   guttata, 6.  
   mucorea, 5.  
 EUCORYSSES, lvi, p. 166.  
   grandis, 166.  
   pallens, 167.  
   superbus, 166.  
 EURHYNCHOCORIS, lviii, p. 51.  
   sparsipunctatus, 51.  
 EUOSTUS, lviii, p. 69.  
   grossipes, 70.  
   validus, 69.  
 EURYASPIS, lvii, p. 182.  
   transversalis, 183.  
 EURYDEMA, lvii, p. 51.  
  
   albiventris, var., 52, 188.  
   Christophi, var., 184.  
   cruentatum, var., 52.  
   dauricum, 53.  
   decoratum, var., 183.  
   dominulum, 53, 183, 184.  
   Fallenii, var., 54.  
   festivum, 52, 183.  
   Hoffmanseggii, var., 54.  
   lhesgicum, var., 53.  
   maracandicum, var., 183.  
   mebadiense, var., 184.  
   multipunctata, 56.  
   ornatum, 54, 184.  
   pulchrum, 55.  
   sumatrana, 55.  
   ventralis, var., 54, 184.  
   Wilkinsi, 54.  
 EURYGASTER, lvi, p. 187.  
   cognatus, 188.  
   maurus, 187.  
   nigra, var., lvii, p. 183.  
   orientalis, lvi, p. 188.  
   signata, var., lvii, p. 183.  
 EURYSASPIS, lvii, p. 182.  
 EUSARCORIS, lvii, p. 41.  
 EUSTHENES, lviii, p. 63.  
   antennatus, 68.  
   cupreus, 67.  
   elephas, 64.  
   eurytus, 67.  
   Hercules, 66.  
   minor, 65.  
   Polyphemus, 68.  
   r bustus, 64.  
   saevus, 68.  
   sontellaris, 65.  
   Theseus, 67.  
 EYSARCORIS, lvii, p. 41.  
   distacta, 40.  
   dubia, 40.  
   epistomalis, 183.  
   guttigerus, 39.  
   Helferi, 183.  
   inconspicuus, 42, 183.  
   insocius, 43.  
   Mayeti, var., 42.  
   megaspilus, 42.  
   misellus, 42.  
   nepalensis, 39.  
   pseudoaeneus, 183.  
   rugulosus, var., 39.  
   simplex, 42.  
   ventralis, 41.  
  
 F.  
 FITHA, lvi, p. 191.  
   ardens, 191.  
  
 G.  
 GALOSTHA, lvi, p. 166.

- equus*, 179.  
*Stockerus*, 181.  
**GAMPSOTES**, lvi, p. 52.  
     *parallelus*, 52.  
**GELLIA**, lviii, p. 105.  
     *nigripennis*, 105.  
     *obtusa*, 106.  
**GEOBIA**, lvi, p. 45.  
**GEOCORISAE**, lvi, p. 23.  
**GEOTOMUS**, lvi, p. 55.  
     *abdominalis*, 57.  
     *elongatus*, 56.  
     *jucundus*, 56.  
     *minutus*, 56.  
     *pygmaeus*, 55.  
     *subtristis*, 56.  
**GLOBOCORIS** lvi, p. 30.  
**GLYPsus**, lvii, p. 179.  
     *fuscispinus*, 179.  
**GONOPSIS**, lviii, p. 100.  
     *rubescens*, 100.  
**GRAPHOSOMA**.  
     *trimaculata*, lvii, p. 180.  
**GYNENICA**, lvii, p. 45,  
     *affinis*, 46.  
     *marginella*, 46.  
     H.  
**HALYOMORPHA**, lvii, p. 23.  
     *murres*, 25.  
     *picus*, 23.  
     *scutellata*, 24.  
     *timorensis*, 23.  
**HALYS**, lvii, p. 7.  
     *alternans*, lvi, p. 205.  
     *amygdali*, lvii, p. 4.  
     *assimilis*, 10.  
     *clavata*, lvi, p. 203.  
     *concinna*, 204.  
     *dentata*, lvii, p. 8.  
     *emulpta*, 4.  
     *hellenica*, 4.  
     *mucorea*, 5.  
     *nigricollis*, lvi, p. 204.  
     *nubila*, lvii, p. 48.  
     *obscura*, lvi, p. 204.  
     *oculata*, 202.  
     *serricollis*, lvii, p. 8.  
     *serrigera*, 7.  
     *timorensis*, 23.  
     *versicolor*, lvi, p. 203.  
**HOFFMANSEGIELLA**, lvii,  
     p. 148.  
     *curtisipina*, 148.  
**HOPLISTODERA**, lvii, p. 68.  
     *incisa*, 69.  
     *trimaculata*, 130.  
     *virescens*, 69.  
**HOTRA**, lvi, p. 184.  
     *curculionides*, 185.  
     *diffusa*, 186.  
     *nigrorufa*, 185.  
**HYLLUS**, lvii, p. 122.  
     *aeruginosus*, 123.  
     *florens*, 123.  
**HYPENCHA**, lviii, p. 59.  
     *apicalis*, 60.  
     *luctuosa*, 59.  
     *ophthalmica*, 60.  
     *Reriki*, 60.  
**HYPERONCUS**, lvi, p. 148.  
     *lateritius*, 148.  
     J.  
**JURTINA**, lvii, p. 145.  
     *indica*, 145.  
     L.  
**LACTISTES**, lvi, p. 42.  
     *rastellus*, 43.  
     *truncato-serratus*, 44.  
     *vicinus*, 43.  
**LAMPROCORIS**, lvi, p. 181.  
     *lateralis*, 182.  
     *obtusus*, 183.  
     *Roylii*, 182.  
     *spiniger*, 183.  
**LAMPROPHARA**, lvi, p. 164.  
**LAPRIUS**, lvii, p. 13.  
     *gastricus*, 14.  
     *varicornis*, 13.  
**LEGNOTUS**, lvi, p. 59.  
     *brevipennis*, 59.  
**LYGAECUS**.  
     *argus*, lvii, p. 182.  
     *hastatus*, 107.  
     *mactans*, lvii, p. 182.  
     *malabaricus*, 182.  
     M.  
**MACRINA**, lviii, p. 102.  
     *coccinea*, 103.  
     *dilatata*, 102.  
**MACROSCYTUS**, lvi, p. 53.  
     *brunneus*, 54.  
     *expansus*, 55.  
     *foveolus*, 53.  
**MATTIPHUS**, lviii, p. 70.  
     *aeruginosus*, 71.  
     *carrenvi*, 71.  
     *laticallus*, 71.  
     *nigridorsis*, 72.  
     *oblongus*, 71.  
**MECIDEA**, lvi, p. 201.  
     *indica*, 201.  
**MEGARHYNCHUS**, lviii, p. 106.  
     *diversus*, 108.  
     *elongatus*, 107.  
     *hastatus*, 107.  
     *limatus*, 108.  
     *quadripinosus*, 104.  
     *rostratus*, 107.  
     *testaceus*, 107.  
     *transversalis*, 108.  
     *truncatus*, 107.  
**MEGYMENUM**, lviii, p. 91.  
     *brevicornis*, 92.  
     *cupreum*, 93.  
     *inermis*, 93.  
     *Meratii*, 93.  
     *subpurpurascens*, 93.  
**MELANOPHARA**, lvi, p. 199.  
     *dentata*, 199.  
**MENIDARIA**, lvii, p. 138.  
**MENIDA**, lvii, p. 139.  
     *distincta*, 141.  
     *flavovaria*, 140.  
     *formosa*, 140.  
     *histrio*, 142.  
     *Signoretii*, 139.  
     *varipennis*, 141.  
**MICRODEUTERUS**, lviii, p. 20.  
     *Dallasi*, 21.  
     *megacephalus*, 21.  
**MORMIDEA**.  
     *baccarum*, lvii, p. 81.  
     *florens*, 123.  
     *nigriceps*, 165.  
     *nigricornis*, 29, 30.  
     *socia*, 165.  
**MUSCANDA**, lviii, p. 83.  
     *testacea*, 84.  
**MYROCHARIA**, lvii, p. 12.  
     N.  
**NEUROSCIA**, lvii, p. 48.  
     *grata*, 48.  
     *sulciiventris*, 48.  
**NEZARA**, lvii, p. 119.  
     *pellucida*, 143.  
     *prasina*, 119.  
     *amaragdula*, 119.  
     *viridula*, 119.  
**NIPHE**, lvii, p. 19.  
     *cephalus*, 20.  
     *elongata*, 20.  
     O.  
**ODONTOSCELARIA**, lvi, p. 188.  
**ODONTOTARSUS**.  
     *maurus*, lvi, p. 188.  
     *pictus*, 188.  
**ODONTOTARSARIA**, lvi, p. 186.  
**OESTOPIS**, lvii, p. 8.  
     *terra*, 9.  
**ONCOMERUS**.  
     *robustus*, lviii, p. 64.  
**ONCYLASPIS**, lvi, p. 24.  
     *ruficeps*, 25.  
     \* **ORTHOSCHIZOPS**, lvii, p. 10,  
         *assimilis*, 10.

OXYPRYMNA, lvi, p. 145.

Spinolae, 145.

OXYLOBUS, lviii, p. 79.  
nigromarginatus, 80.

P.

PACHYCORIS.

curculionides lvi, p. 185.

nepalensis, 150.

punctulatus, 185.

PALOMENA, lvii, p. 27.

amplificata, 28.

Renteri, 27.

spinosa, 27.

viridissima, 28.

PARAMECOCORIS.

gastricus, lvii, p. 14.

PARAMECUS, lvii, p. 17.

ruficornis, 17.

PELTOXYS, lvi, p. 59.

brevipennis, 59.

pubescens, 59.

PENTATOMA.

albonotata, lvii, p. 161.

aliena, 177.

anchora, 135.

arabica, 32.

aurantiacum, 71.

baccarum, 30, 31.

bengalensis, 161.

berylina, 120.

bimaculata, 44.

cephalus, 20.

chinensis, 120.

chloris, 120.

chlorocephala, 120.

coeruleum, 169.

concinna, 169.

confusa, 31.

crassiventre, 162.

crossota, 124.

cruciata, 135, 137.

decorata, 183.

elongata, 20.

fimbriata, Westw., 162.

fimbriata, Fabr., 124.

fimbriolata, Germ., 184.

fimbriolatum, H. S., 124.

flavicollis, 120.

flavicornis, 120.

formosa, 140.

grata, 48.

Haly, 23.

inconcisa, 163.

inconspicuum, 42.

indica, 161.

Janus, lviii, p. 83.

lateralis, Wlk., lvii, 163.

lateralis, Westw., 162.

latipes, 26.

Leet, 120.

lineatocollis, 37.

luridum, 181.

maculicollis, 32.

misella, 42.

nepalensis, 89.

nigricornis, 29.

nigripes, 71.

obscura, 44.

ornata, 54.

pallicornis, 41.

pallida, 30.

parvula, 34.

picta, 52.

plicaticollis, 120.

propinqua, 120.

proxima, 120.

pulchra, Westw., 55.

pulchra, Dallas, 136.

punctipes, 39.

pusilla, 183.

smaragdula, 119.

sublurida, 181.

subsericea, 120.

taprobanensis, 22.

timorensis, 23.

trimaculata, 1.

tripunctigera, 120.

trispila, 164.

trivialis, 23.

unicolor, Westw., 120.

unicolor, Westw., 161.

varipennis, 141.

ventralis, 41.

verbasci, 31.

verrucosa, 172.

vicaria, 163.

violacea, 169.

PENTATOMIDAE, lvi, p. 23.

PENTATOMINA, lvi, p. 192:

lvii, p. 16.

PHYLLOCEPHALINA, lviii, p. 96.

PHYLLOCEPHALA, lviii, p. 97.

distans, 102.

furcata, 104.

glandulosa, 98.

PICROMERUS, lvii, p. 177.

nigrivitta, 178.

obtusius, 178.

robustus, 178.

spinidens, 177.

PIEZODORUS, lvii, p. 143.

rubrofasciatus, 143.

PIEZOSTERNUM, lviii, p. 82.

cribratum, 83.

firmatum, 83.

ingenuum, 83.

PLACOSTERNUM, lvii, 158.

alces, 160.

dama, 160.

cervus, 159.

taurus, 159.

PLATASPINA, lvi, p. 23.

PLATASPIS, lvi, p. 24.

nitens, 24.

nitidus, 29.

ruficeps, 25.

subaenea, 28.

Vahlis, 27.

PLATYCEPHALA, lvi, p. 26.

PLATYDIUS, lviii, p. 93.

subpurpurascens, 93.

PLATYPLEURUS, lvi, p.

187.

PLAUTIA, lvii, p. 124.

fimbriata, 124.

PLEXIPPUS, lvii, p. 18.

dorsalis, 18.

PODISUS, lvii, p. 180.

angustus, var., 181.

luridus, 180.

PODOPARIA, lvi, p. 192.

PODOPS.

bispinosus, lvi, p. 195.

limosus, 197.

luridus, 194.

niger, 196.

obscurus, 196.

spinifera, 196.

tarsalis, 195.

POECILOCHROMA, lvi, p.

150.

Childreni, lvi, p. 150.

Druræi, 153.

Hardwickii, 151.

interrupta, 155.

lata, 152.

obesa, 158.

ornata, 158.

pulchra, 156.

purpurascens, 156.

rufigenis, 158.

POECILOCORIS, lvi, p. 150.

anisospilus, 159.

Childreni, 157.

Druræi, 153.

Hardwickii, 150.

interruptus, 155.

latus, 152.

obesus, 158.

obsoletus, 154.

ornatus, 153.

pulcher, 156.

purpurascens, 156.

rufigenis, 158.

POECILOMETIS.

mistus, lvii, p. 23.

POSEIDON, lvi, p. 25.

malayanus, 26.

PRIONACA, lvii, p. 157.

exempta, 158.

lata, 158.

**PRIONOCHILUS**, lvii, p. 156.

*octopunctatus*, 157.

**PYCANUM**, lviii, p. 75.

*amethystinum*, 76.

*amplicolle*, 74.

*Amyoti*, 74.

*angulatum*, 78.

*jaspideum*, 78.

*negromarginatum*, 80.

*pallipes*, 79.

*ponderosum*, 77.

*pretiosum*, 77.

*rubens*, 75.

*rubidum*, 78.

*smaragdiferum*, 78.

*stabile*, 78.

**PYGOPLATYS**, lviii, p. 61.

*acutus*, 61.

*minax*, 62.

*roseus*, 61.

## R.

**RHAPHIGASTER**.

*albida*, lvii, p. 140.

*apicalis*, 166.

*bisignatus*, 167.

*concinuus*, 142.

*flavolineatus*, 143.

*flavovarius*, 140.

*humeralis*, 122.

*macracanthus*, 166.

*oceanicus*, 143.

*orbis*, 120.

*patulus*, lvii, p. 167.

*prasinus*, 119.

*rubriplaga*, 168.

*smaragdulus*, 120.

*spectandus*, 140.

*spinosus*, 122.

*strachioides*, 167.

*subsericeus*, 120.

*torquatus*, 120.

*viripennis*, 141.

*virescens*, 143.

**RHYNCHOCORARIA**, lvii, p. 147.

**RHYNCHOCORIS**, lvii, p. 149.

*humeralis*, 150.

*octopunctatus*, 157.

*serratus*, 150.

## S.

**SABAEUS**, lvii, p. 121.

*spinosis*, 122.

**SAGRIVA**.

*vittata*, lviii, p. 96.

**SASTRAGALA**, lviii, p. 27.

*binotata*, 28.

*heterospila*, 29.

*lineata*, 28.

*mustelina*, 29.

*parmata*, 30.

*rufispina*, 29.

*uniguttata*, 29.

**SCAPTOCORIS**, lvi, p. 39.

*callidus*, 41.

*molginus*, 39.

*tabulatus*, 40.

**SCHIZMATOPS**, lviii, p. 100.

**SCHIZOPS**, lviii, p. 99.

*insignis*, 100.

**SCHYZOPS**, lviii, p. 99.

**SCIOCORIS**, lvii, p. 11.

*indicus*, 12.

*lateralis*, 11.

*varicornis*, 13.

**SCOPARIPES**, lvi, p. 44.

*longirostris*, p. 45.

**SCOTINOPHARA**, lvi, p. 193.

*affinis*, 193.

*bispinosa*, 194.

*coarctata*, 195.

*limosa*, 197.

*lurida*, 194.

*nigra*, 196.

*obscura*, 196.

*spinifera*, 196.

*tarsalis*, 195.

**SCUTELLARIA**, lvi, p. 148.

**SCUTELLERINA**, lvi, p. 145.

**SCUTELLERA**, lvi, p. 161.

*amethystina*, 163.

*Buqueti*, 165.

*cincta*, 33.

*dilatocollis*, 181.

*dispar*, 149.

*Druræi*, 153.

*eques*, 179.

*fasciata*, 162.

*Hardwicki*, 151.

*interrupta*, 155.

*lamæ*, 163.

*lateralis*, 182.

*nobilis*, 161.

*oblonga*, 164.

*patrica*, 172.

*pulchella*, 182.

*purpurascens*, 156.

*rubropunctata*, 147.

*Stockerus*, 174, 175.

*trmaculata*, lvii, p. 130.

**SCYLAX**, lvii, p. 34.

*macrinus*, 35.

*porrectus*, 35.

**SEBIUS**, lvi, p. 60.

*bicolor*, 60.

**SESHA**.

*manifesta*, lvii, p. 171.

**SIPHUS**, lviii, p. 57.

*Alcides*, 58.

*dilatatus*, 58.

*Hector*, 58.

**SOLENOSTETHIUM**, lvi, p. 146.

*chinense*, 147.

*rubro-punctatum*, 147.

**SOLENOSTHEDIUM** lvi, p. 146.

**SOPHELA**, lvi, p. 181.

*spnigera*, 183.

**SPHAEROCORARIA**, lvi, p. 147.

**SPHAEROCORIS**, lvi, p. 148.

*lateritius*, 148.

**STENOZYGUM**, lvii, p. 56.

*speciosum*, 57.

**STIBAROPUS**, lvi, p. 38.

*brunneus*, 39.

*callidus*, 41.

*flavidus*, 41.

*latipes*, 39.

*minor*, 42.

*molginus*, 39.

*tabulatus*, 40.

*testaceus*, 42.

**STORTHECORIS**, lvi, p. 197.

*nigriceps*, 197.

**STIRETRUS**

*coeruleus*, lvii, 169.

**STOLIA**, lvii, p. 38.

*distacta*, 40.

*dubia*, 40.

*fuliginosa*, 39.

*guttigera*, 39.

*misella*, 42.

*rectipes*, 40.

*rugulosa*, 39.

**STRACHIA**, lvii, p. 60.

*afflicta*, 61.

*conspicua*, 54.

*crucigera*, 60.

*decorata*, 184.

*designata*, 62.

*dissimilis*, 184.

*festiva*, 53.

*flammula*, 60.

*herbacea*, 54.

*heterospila*, 65.

*inornata*, 61.

*limbata*, 59.

*liturifera*, 62.

*ornata*, 54.

*pardalis*, 64.

*pectoralis*, 184.

*picta*, Hahn, 52.

*picta*, Dallas, 58.

*platyspila*, 64.

*pulchra*, 55.

*pustulata*, 184.

*securigera*, 63.

*speciosa*, 57.

*strangulata*, 61.

*velata*, 65.

- T.  
**TABICHEA**, lvi, p. 23.  
*chinensis*, 35.  
*nitens*, 24.  
**TACTOCORIS**.  
*affinis*, lvi, p. 150.  
*Childrenii*, 157.  
*Hardwickii*, 150.  
*interrupta*, 155.  
*nepalensis*, 163.  
*nobilis*, 162.  
*oblonga*, 164.  
*obscura*, 165.  
*perplexa*, 162.  
*purpurascens*, 156.  
**TESSERATOMINA**, lviii, p. 52.  
**TESSARATOMA**, lviii, p. 53.  
*alternata*, 75.  
*angularis*, 55.  
*apicalis*, 60.  
*chinensis*, 56.  
*conspersa*, 55.  
*cornuta*, 53.  
*cuprea*, 67.  
*furcifera*, 57.  
*javana*, 55.  
*javanica*, 55.  
*luctuosa*, 59.  
*malaya*, 54.  
*nigripes*, 54.  
*obscura*, 85.  
*ophthalmica*, 60.  
*ossa-cruenta*, 56.  
*papillosa*, Drury, 56.  
*papillosa*, Blanch, 55.  
*picea*, 60.  
*proxima*, 55.  
*robusta*, 64.  
*scutellaris*, 65.  
*Sonneratii*, 56.  
*taurus*, 53.  
*timorensis*, 55.  
**TETRARTHRIA**, lvii, p. 159.  
*lineata*, 160.  
*marginepunctata*, 160.  
*quinquemaculata*, 160.  
*tetraspila*, 167.  
*variegata*, 160.  
**TETRATOMA**, lvii, p. 37.  
**TETRISIA**, lvii, p. 168.  
*bruchoides*, 168.  
**TETRODA**, lviii, p. 108.  
*atomaria*, 104.  
*bilineata*, 105.  
*divaricata*, 104.  
*histeroides*, 104.  
*nigripennis*, 105.  
*obtusa*, 106.  
*transversalis*, 108.  
**TETTYRA**.  
*baro*, lvi, p. 167.  
*bispinosa*, 194, 195.  
*cribraria*, 81.  
*dispar*, 149.  
*Druraei*, 163.  
*eques*, 179.  
*lurida*, 194.  
*maura*, 187, 188.  
*nobilis*, 162.  
*patricia*, 172.  
*picta*, 188.  
*silphoides*, 28.  
*Stockerus*, 174.  
*Vahlvi*, 27.  
**THALMA**, lviii, p. 94.  
*bigutta*, 94.  
**THYREOCORIS**.  
*austriacus*, lvi, p. 188.  
*cinctus*, 33.  
*circumscribitus*, 32.  
*cribraria*, 81.  
*duodecimpunctatus*, 30.  
*nepalensis*, 32.  
*nitidus*, 29.  
*seminulus*, 33.  
*septus*, 28.  
*silphoides*, 29.  
*sphaerula*, 33.  
*Vahlvi*, 27.  
*variegatus*, 33.  
**TOLUMNIA**, lvii, p. 26.  
*latipes*, 26.  
**TRITOMEGAS**, lvi, p. 60.  
*bicolor*, 60.  
**TROPICORARIA**, lvii, p. 150.  
**TROPICORIS**, lvii, p. 151.  
*laeviventris*, 151.  
*punctipes*, 152.  
**TYLONCA**, lvi, p. 185.  
**TYPHLOCORIS**, lviii, p. 47.  
*semicircularis*, 48.  

U.

**UDANA**, lvi, p. 202.  
**UROCHELA**, lviii, p. 38.  
*bimaculata*, 41.  
*discrepans*, 42.  
*ferruginea*, 43.  
*guttulata*, 40.  
*obscura*, 41.  
*pilosa*, 40.  
*pulchra*, 42.  
*quadripunctata*, 39.  
**UROLABIDA**, lviii, p. 47.  
*binotata*, 49.  
*Chennelli*, 50.  
*Grayii*, 48.  
*histrionica*, 48.  
*khasiana*, 50.  
*semicircularis*, 48.  
*tenera*, 49.  
*uniloba*, 49.  
**UROLABIDINA**, lviii, p. 38.  
**UROSTYLINA**, lviii, p. 38.  
**UROSTYLIS**, lviii, p. 43.  
*fumigata*, 45.  
*gracilis*, 44.  
*histrionicus*, 48.  
*lopoides*, 46.  
*nigromarginatus*, 46.  
*notulata*, 44.  
*pallida*, 44.  
*philoides*, 45.  
*punctigera*, 48.  

V.

**VIRBIUS**, lviii, p. 73.  
*angulatus* 73.  

Z.

**ZANGIS**, lvii, p. 125.  
*beryllus*, 125.  
**ZICRONA**, lvii, p. 169.  
*coerulea*, 169.  
*illustris*, 169.

# INDEX. †

 Names of New Genera and Species have an asterisk (\*) prefixed.

- Acanthodrilus*, 111  
*Acesina*, 412.  
*Acræa*, 134  
*Acrotema*, 361, 363  
     " *costatum*, 363  
     " *Wrightianum*, 364  
*Actias*, 416  
*Actinurus*, 352  
     " *neptunius*, 351  
 \* " *ovatus*, 351, 358  
*Adelpha*, 126  
*Æcidium*, 238, 240, 242, 243, 245, 248,  
     250, 251  
     " *setosa*, 251  
     " *Strobilanthis*, 243  
     " *Urticæ*, 234, 250  
     " " *var. Himalayense*,  
         234, 244  
     " *Wallichii*, 251  
 \* *Ælurillus quadrimaculatus*, 334  
*Æmona amathusia*, 118, 124  
     " *pealii*, 124  
*Æsopia cornuta*, 287  
*Æthalochroa*, 310, 318  
     " *affinis*, 313  
     " *ashmolia*, 312  
     " " *var. insignis*,  
         313  
     " " *var. simpli-*  
         *cipes, ib.*  
 \* " *spinipes, ib.*  
*Agarista*, 131, 134  
*Agrostis*, 249  
     " *Hookeriana*, 249, 251  
*Allotinus*, 414, 415, 436, 437, 440  
     " *alkamah*, 437, 438  
     " *aphocha*, 437  
     " *drumila, ib.*  
     " *multistrigatus, ib.*  
     " *nivalis*, 436, *ib.*  
     " *subviolaceus, ib.*  
     " *unicolor, ib.*  
*Alsodeia*, 399, 400  
 \* " *capillata*, 407  
 \* " *cinorea*, 403  
     " " *var. hirsutiflora*, 404  
 \* " *comosa*, 407  
 \* " *condensa*, 405  
     " *dasycaula*, 402  
     " *dasyptyxis*, 405  
     " *echinocarpa*, 406, 407  
 \* " *floribunda*, 406  
 \* " *Hookeriana*, 402, 403  
 \* " *Kunstleriana*, 401  
     " *lanceolata*, 404, 405  
     " *Maingayi*, 402, *ib.*  
 \* " *membranacea*, 402  
     " *mollis*, 406  
 \* " *pachycarpa*, 408  
 \* " *Scortechinii*, 405, 406  
     " *Wallichiana*, 400, 401  
 \* " *Wnyi*, 403  
*Alsodeiæ*, 399  
*Alytostylis*, 397  
*Amblypodia*, 409, 410  
     " *andersonii*, 426  
     " *narada*, 426  
*Amblypodinæ*, 409  
*Anamirta*, 377, 379.  
     " *Loureiri*, 379  
*Andropogon*, 246  
     " *tristis*, 246  
*Anonacæ*, 359, 376  
*Anthistiria anathera*, 246  
*Antitaxis*, 378, 388  
     " *calocarpa*, 388  
     " *fasciculata, ib.*  
     " *lucida, ib.*  
*Anyphæna accentuata*, 314  
 \* " *soricina*, 344  
*Apatura*, 126  
     " *iris*, 126  
     " *namouna, ib.*  
 \* " *ulupi*, 125, 134

† For a general Index to names used in the papers on *Rhynchota* other than *Coccidæ* in this volume and in the two preceding volumes, see pp. 441—448 of the present volume.



- Apatura* (*Eulacena*) *osteria*, 125  
*Apataridæ*, 125, 126  
*Aphnæinæ*, 413, 426  
*Aphnæus*, 410, 411, 413, 426  
     " *lohita*, 428  
*Aphoristia*, 292, 293  
     " *gilesii*, 293, 295  
 \* " *wood-masoni*, 294, 295  
*Apogon*, 296  
*Appias*, 121  
     " *figulina*, 121  
     " *hippoides*, 120  
     " *leis*, 121  
     " *nero*, *ib.*  
*Apporasa*, 423  
     " *atkinsonii*, 423  
*Araña*, 342  
 \* *Araotes*, 411, 413, 428  
     " *lapithis*, 428  
*Argyropeira* *angustata*, 341  
*Arhopala*, 409, 410, 411, 412, 417  
     " *achelous*, 421  
     " *adorea*, 422  
     " *agaba*, *ib.*  
     " *agelastus*, 418, 419  
     " *agesias*, 421  
     " *agnis*, 418  
     " *aïda*, 421  
     " *albopunctata*, *ib.*  
     " *aliteus*, 420  
     " *ammon*, 421  
     " *anarte*, 417, 418  
     " *anthelus*, 418  
     " *antimuta*, 419  
     " *aroa*, *ib.*  
     " *aronya*, 421  
     " *atosia*, 419  
     " *bazalus*, *ib.*  
 \* " *belphebe*, 421, 410  
     " *critala*, 421  
     " *davisonii*, 419  
 \* " *duossa*, 419, 421, 440  
     " *cumolpus*, 416, 421, 422  
     " *farquharii*, 416, 421, 422  
 \* " *hellenore*, 422, 440  
     " *inornata*, 411  
     " *lycænaria*, 418  
     " *maxwellii*, 416, 422  
     " *metamuta*, 409, 419  
 \* " *mirabella*, 420, 421  
 \* " *pastorella*, 418, 440  
 \* " *perissa*, 419, 440  
     " *subfasciata*, 418  
     " *theba*, 421  
     " *vihara*, 409, 419  
     " *yendava*, 419  
     " (*Nilasera*) *centaurus*, 417  
     " (*Satadra*) *agaba*, 422  
     " " *aïda*, *ib.*  
*Arisæma*, 233  
*Arius*, 280
- \* *Arnoglossus* *macrolophus*, 280, 295.  
 \* " *polylepis*, 290, 295  
*Arrhenothrix*, 428  
*Arrugia*, 415  
*Arsacia*, 310  
     " *ashmoliana*, 312  
*Arundinella* *setosa*, 245  
     " *Wallichii*, *ib.*, 246  
*Astictopterus*, 131  
*Auteupuccinia*, 243  
*Barclaya*, 389, 390  
     " *longifolia*, 390  
     " *mottleyi*, *ib.*  
     " " *var. Kunstleri*, *ib.*  
 \* *Bathymyrus*, 305  
 \* " *echinorhynchus*, *ib.*  
*Bdelloida*, 349  
*Belenois*, 121  
*Biduanda*, 411, 413, 425  
     " *fabricii*, 425  
     " *lapithis*, 413  
     " *molisa*, 425, 426  
 \* " *nicevillei*, 426, 440  
     " *scæva*, 425  
 \* " *scudderii*, 426, 440  
     " *thesmia*, 121, 425, 426  
*Bindahara*, 413  
     " *phocides*, 427  
*Brachionidæ*, 357  
*Brachionus* *bakeri*, 357  
 \* " *bidentata*, *ib.*, 358  
 \* " *longipes*, *ib.*, *ib.*  
     " *militaris*, 357  
     " *urceolaris*, *ib.*  
*Brachypleura*, 282  
 \* " *xanthosticta*, 281, 295  
*Brachypodium* *silvaticum*, 251  
     " *sylvaticum*, 248, *ib.*  
*Bromus*, 246  
*Bybliadæ*, 126  
*Calliana* *pieridoides*, 133  
*Callidula*, 133  
*Capellia*, 364  
*Capila* *jayadeva*, 132  
*Capparidæ*, 359, 391  
*Capparis*, 392  
     " *conspicua*, 394  
 \* " *cucurbitina*, 393, 395  
     " *erythrodasya*, 393  
     " *Finlaysonianana*, *ib.*, 394, 395,  
         396  
 \* " *Kunstleri*, 396  
 \* " *Larutensis*, 393  
     " *micracantha*, *ib.*, 394, 395  
     " *micrantha*, *ib.*  
     " *publiflora*, 393, 394  
     " " *var. Perakensis*, 394  
 \* " *Scortechini*, 393, *ib.*  
     " *sepiaria*, 393  
     " *trinervia*, 394  
*Carchurias*, 280

- Carchesium*, 349  
*Carex* *flicina*, 250  
     *setigera*, 244, *ib.*  
*Castalius*, 413  
     *elna*, 414  
     *ethion*, 434  
     *manluena*, 134  
     *rosimon*, 434  
     *roxus*, *ib.*  
*Castanea indica*, 1  
     *tribuloides*, *ib.*  
*Catapœcilma delicatum*, 121  
*Cathypna luna*, 355  
*Cathypnidæ*, *ib.*  
*Catochrysops*, 434  
     *oneius*, 432  
     *pandava*, *ib.*  
     *strabo*, *ib.*  
*Catopœcilma*, 413  
     *elegans*, 432  
*Catopsilia*, 121, 416  
*\*Cedicus bucculentus*, 343  
     *mærentus*, *ib.*  
*Cephalosiphon limnias*, 347  
*\*Cercidia punctigera*, 341  
*Cervidæ*, 187  
*Cervus*, 186  
     *affinis*, *ib.*  
     *aristotelis*, *ib.*  
     *cashmeerianus*, *ib.*  
     *dybowski*, *ib.*, 187, 188  
     *mantchuricus*, 187  
*Cethosia*, 126, 131  
*Chaibassia*, 327, 328, 329, 331, 333  
     *theobaldi*, 327, 328, 329  
     *tricarinata*, *ib.*, *ib.*, *ib.*  
*Champooodon vorax*, 301, 302  
*Charaxes*, 126  
*Charaxidæ*, *ib.*  
*Cheritra*, 411  
     *freia*, 427  
     *freja*, 130  
*Chilodipteus*, 296  
*Chliaria*, 427  
*\*Chlisma*, *ib.*, 440  
     *merguia*, *ib.*, 440  
     *othona*, 427  
*Chrysophanus*, 410  
*Chrysopogon cœruleus*, 248, 251  
     *gryllus*, 247  
*Circœa alpina*, 235  
*Cirrhochroa*, 432  
*Cissampelidæ*, 377  
*Cissampelos*, 386, *ib.*  
     *caapeba*, 386  
     *convolenlacea*, *ib.*  
     *delicatula*, 387  
     *discolor*, 386, *ib.*  
     *diversa*, 387  
     *elata*, *ib.*  
     *eriantha*, *ib.*  
     *grallatoria*, *ib.*  
*Cissampelos hernandifolia*, 386  
     *hexandra*, *ib.*  
     *hirsuta*, 387  
     *mauritianna*, 385  
     *orbiculata*, 387  
     *Pareira*, 386  
     *sub-peltata*, 387  
*Cistudo*, 332  
*Clematidæ*, 359, 360  
*Clematis*, 360  
     *cana*, *ib.*  
     *dentosa*, *ib.*  
     *glandulosa*, *ib.*  
     *Gouriana*, *ib.*  
     *javana*, *ib.*  
     *Munroana*, *ib.*  
     *similacifolia*, *ib.*  
     *similacina*, 361  
     *sub-peltata*, 360  
*Clemmys*, 332  
     *trijuga*, 327  
*Cleome*, 391  
     *aspera*, 392  
     *Burmanni*, *ib.*  
*\*C. Hullettii*, *ib.*  
     *pentaphylla*, *ib.*  
     *viscosa*, 392  
*\*Clubiona germanica*, 344  
*\*Clypea Burmanni*, 387  
     *hernandifolia*, 386  
*Coccidæ*, 1  
*Coccina*, *ib.*  
*Cocculæ*, 377  
*Cocculus*, *ib.*, 384, 385  
     *Blumeanus*, 382  
     *Blumeanus*, 381, *ib.*  
     *coriaceus*, 378  
     *crispus*, *ib.*  
     *incanus*, 385  
*\*C. Kunstleri*, 384  
     *macrocarpus*, 385  
     *oblongus*, 382  
     *peltatus*, 387  
     *petiolaris*, 378  
     *triandrus*, 382  
     *velutinus*, 383  
     *verrucosus*, 378  
*Colbertia obovata*, 367  
*Coluridæ*, 355  
*Colurus caudatus*, *ib.*  
*Comosa*, 278  
*Compositæ*, 251  
*Coniferæ*, 232  
*Coscinum*, 377, 381  
     *Blumeannum*, 381  
     *fenestratum*, *ib.*  
     *Maingayi*, *ib.*  
     *Wallichianum*, *ib.*  
     *Wightianum*, *ib.*  
*Coltidæ*, 303

- Cratæva*, 397, 399  
 „ *hygrophila*, 398  
 „ *lophosperma*, 399  
 „ *macrocarpa*, 397  
 „ *magna*, 398  
 „ *membranifolia*, *ib.*  
 „ *Narvala*, 399  
*Cupitha*, 132  
*Curetis*, 410  
 „ *malayica*, 428  
*Cyaniris*, 128, 435  
 „ *akasa*, 435  
 „ *danis*, 421  
 „ *duponchelii*, 435  
 „ *haraldus*, *ib.*  
 „ *jynteana*, *ib.*  
 \* „ *metæna*, 434, 440  
 „ *placida*, 434  
 „ *pupa*, *ib.*, 435  
 „ *transpecta*, 434  
*Cyclea*, 378, 387  
 „ *Arnotlii*, 387  
 „ *barbata*, *ib.*  
 „ *Burmanni*, *ib.*  
 \* „ *elegans*, *ib.*  
 „ *laxiflora*, *ib.*  
 „ *peltata*, *ib.*  
 „ *pendulina*, *ib.*  
 „ *versicolor*, *ib.*  
*Cyclemys*, 332  
 \* *Cyclosa fissicarinata*, 338  
 „ *oculata*, *ib.*  
 \* „ *spirifera*, 337  
*Cyllene*, 133  
*Cynoglossus*, 280, 290  
 „ *bengalensis*, 288  
 „ *brevis*, 289  
 \* „ *carpenteri*, 287, 295  
 \* „ *intermedius*, 288  
 „ *lida*, *ib.*  
 „ *macrolepidotus*, *ib.*  
 „ *melanopterus*, 289  
 „ *monopus*, *ib.*  
 „ *oligolepis*, 288  
 „ *puncticeps*, 289  
 „ *quadrilineatus*, 288  
 „ *semifasciatus*, 289  
*Cynthia*, 126  
*Cyrestis*, 130  
*Dacalana*, 428  
 „ *vidura*, 130, 428  
*Danuria*, 306  
 „ *bolanana*, *ib.*  
 „ *buchholzi*, *ib.*  
 „ *elongata*, *ib.*  
 „ *superciliaris*, *ib.*  
 „ *thunbergi*, *ib.*  
*Darasana*, 412  
 „ *perimpta*, 423  
*Davilla hirsuta*, 362  
*Delima*, 361  
*Delima glabra*, 362  
 „ *hebecarpa*, *ib.*  
 „ *intermedia*, *ib.*  
 „ *lævis*, *ib.*  
 „ *sarmentosa*, *ib.*  
 „ „ *var. glabra*, *ib.*  
 „ „ *hebecarpa*, *ib.*  
*Delimæ*, 361  
*Delimopsis hirta*, 362  
*Deramas*, 417, 430  
*Dendorigina*, 412, 413, 428  
*Dendorix*, 413, 414  
 „ *epiarbas*, 428  
 „ *epijarbas*, *ib.*  
*Diglena forcipata*, 353  
*Dilipa morgiana*, 125, 126  
*Dillenia*, 361, 365, 366, 367, 368  
 „ *aurea*, 367  
 „ *elliptica*, 366  
 „ *eximia*, 368  
 „ *grandifolia*, *ib.*  
 „ *indica*, 366  
 „ *moliosmæfolia*, 365  
 „ *ornata*, 367  
 „ *ovata*, 366  
 \* „ *reticulata*, 367  
 „ *speciosa*, 366, *ib.*  
*Dilleniaceæ*, 359, 361  
*Dilleniæ*, 361  
*Dinocharidæ*, 353  
*Diplochæia*, 385  
 „ *pictinervis*, *ib.*  
*Dolenschallinae*, 126  
*Dophla derma*, 122  
 „ *dunya*, *ib.*  
 „ *evelina*, *ib.*  
*Drina donina*, 428  
*Drupadia*, 411, 425  
 „ *boisduvalii*, 425  
 „ *moorei*, 425  
*Dyctis pealii*, 124, 134  
*Elymniadæ*, 124  
*Elymnias*, 423  
 „ *candata*, 124  
*Emydidæ*, 328  
*Emys*, 332  
*Eëoxyliodes*, 410, 411  
 „ *tharis*, 411  
*Epeira alpica*, 339  
 \* „ *camilla*, 338  
 „ *dioidia*, 340  
 „ *dromadaria*, 338, *ib.*  
 \* „ *himalayana*, 339  
 „ *laglaizei*, 339  
 \* „ *minutalis*, 340  
 \* „ *nympha*, 339  
 „ *prædata*, *ib.*  
 „ *thelura*, *ib.*  
 „ *triguttata*, 340  
*Epistylis*, 349  
*Epuccinia*, 244

- Equula*, 280  
*Erycinidae*, 126, 130, 432  
*Euchera*, 133  
*Euchlanidae*, 355  
*Euchlanis macrura*, *ib.*  
*Eulaceura osteria*, 125  
*Euptea*, 119, 133  
     " core, 119  
     " kollari, *ib.*  
     " linnæi, 131  
     " midamus, 119, 131  
*Eupteopsis telearchus*, 130  
*Eupuccinia*, 235, 243  
*Euripinae*, 126  
*Eurytelidae*, *ib.*  
*Euthalia*, 121, *ib.*  
     " aconthea, 122  
     " anyte, 122  
     " durga, *ib.*, 123  
     " francie, 122  
     " garuda, *ib.*  
     " jama, *ib.*  
     " kesava, *ib.*  
     " lubentina, *ib.*  
     " nara, *ib.*  
     " patala, *ib.*  
     " phemius, *ib.*  
     " sahadewa, *ib.*  
     " telchinia, *ib.*  
     " vasanta, *ib.*  
*\*Euthyphleps*, 315  
     " rectivenis, 317  
*Euwormia*, 365, 366  
*Everes*, 434  
     " kala, 433, 434  
     " nysens, 434  
     " parrhasius, *ib.*  
     " putli, *ib.*  
*\*Euplois*, 433, *ib.*, 440  
*Fapilo*, 415  
*Felderia andersonii*, 122  
     " cocytina, *ib.*  
     " iapis, *ib.*  
     " lepidea, *ib.*  
     " macnairi, *ib.*  
     " satropaces, *ib.*, 123  
*Festuca gigantea*, 249  
*Fibraurea*, 377, 380  
     " chloroleuca, 380  
     " tinctoria, *ib.*  
*\*Flos*, 412, 423  
     " absens, 423  
     " apidanus, 412, 423  
*\*Floscularia*, 423, 440  
*Floscularia ambigua*, 346  
     " campanulata, *ib.*  
     " ornata, 345  
     " tenuilobata, 346, 358  
*Flosculariidae*, 345  
*Forma crepidis*, 238  
     " Hieracii, *ib.*  
*Fragaria vesca*, 244  
*Furcularia forficula*, 353.  
     " longiseta, *ib.*  
*Galium aparino*, 239  
*Gasteracantha*, 336  
*\*Gehlotia*, 131  
     " unguifera, *ib.*  
     " hypsina, *ib.*  
     " pinwilli, *ib.*  
*Geocomyda*, 323, 329  
     " tricarinata, 328  
*Geometra*, 416  
*Geranium*, 232  
     " nepalense, 236  
*Gerydinae*, 128, 414, 416, 436, 437  
*Gerydus*, 415, 440  
*\*Gerydus*, 438, 439, 440  
     " biggsii, 440  
     " boisduvallii, *ib.*  
*\*Glyptogona*, 439, *ib.*  
     " croton, 439, *ib.*  
*\*Glyptogona excelsa*, 337  
     " sextuberculata, *ib.*  
*Gynandropsis*, 392  
     " affinis, 392  
     " pontaphylla, *ib.*  
*Hamadryas*, 126  
*Hebomoia*, 121  
*Hemicoccina*, 1  
*Hemipuccinia*, 237, 242, 243  
*Herona*, 122  
*Hesperia*, 415  
     " satwa, 132  
*Hesperidae*, 126, 131, 133.  
*Hestias*, 131  
*Heterochaeta*, 307, 321  
     " tennipes, 308  
     " tricolor, 309  
*\*Heterochaetula*, 308, 321  
*\*Heterochaetula*, 308, 321  
     " fissispinis, 309  
     " tricolor, *ib.*  
*Hieracium*, 238  
*\*Homalattus mus*, 335  
*Horaga onyx*, 428  
*Hymettus*, 133  
*Hypolimnas*, 126  
     " anomala, 121  
     " bolina, 120  
     " jacintha, *ib.*  
*Hypolycæna erylus*, 427  
     " libna, 413, 436  
*Hypsochaeris*, 377, 383, 384  
     " triflora, 384  
*Icio*, 335  
*\*Idiocerus atkinsoni*, 252  
     " clypealis, *ib.*  
     " niveosparus, *ib.*  
     " notatus, *ib.*  
*Ilerda brahma*, 417  
*Illicium*, 369, 374  
*Illoricatea*, 352  
*Indoxylides*, 410

- Iois, 411  
 Iraota, 410  
 Ismene, 132, 133  
 Ixias, 119, 120  
 Jamides, 433  
 Jasminum grandiflorum, 232  
 Junonia, 118, 126  
 Kadsura, 369, 375  
   " cauliflora, 375  
   " japonica, 376  
 \* " lanceolata, *ib.*  
   " Roxburghiana, *ib.*  
   " scandens, 375, *ib.*  
 Kallima, 126  
 Kerana, 131  
 Kermes, 1, 2  
 Kurtus, 280  
 Laciularia, 349  
 Lampidæ, 409  
 Lampides, 417, 421, 433  
   " ælianus, 433  
   " bochus, *ib.*  
   " elpis, 421  
   " marakata, 417  
   " subdita, 433  
 Larinia chlorei, 341  
   " pubiventri, *ib.*  
 \* " quadrinotata, 340  
 Lecanina, 1  
 Lehera, 413  
   " cryx, 416  
 Lemoniadæ, 413  
 Lemoninæ, 126  
 Leontoglossum scabrum, 362  
 Lepidoptera, 416  
 Leptopuccinia, 332, 233, 240  
 Lethe, 124, 133  
   " hyrania, 124  
   " margaritæ, *ib.*  
 \* " naga, 123, 134  
   " verma, 124  
 Lexias cyanipardus, 122, 123  
   " dirtea, *ib.*, *ib.*  
   " recta, 121  
   " teuta, *ib.*  
   " teutoides, *ib.*  
 Libythea, 126  
 Limacia, 377, 382, 383, 384, 387  
   " Amherstiana, 382  
   " cuspidata, 384  
   " distincta, 383  
   " inornata, *ib.*  
   " Kunstleri, *ib.*  
   " microphylla, 384  
   " oblonga, 382  
   " triandra, *ib.*  
   " velutina, 383  
   " " var. glabrescens, *ib.*  
   " Wallichiana, 382  
 Limenitis, 126  
 Limnias annulatus, 347  
 Limnias ceratophylli, 347  
 Liphyra, 414, 415  
   " brassolis, 129, 416  
 Liphyrinæ, 409, 416, 440  
 Logania, 128, 414, 415, 436, 440  
   " andersonii, 413, 436  
   " malayica, 436  
   " marmorata, 415, *ib.*  
   " sriwa, 415  
   " substrigosa, 436, 437  
 Lophius, 302  
 \* " indicus, *ib.*  
   " setigerus, *ib.*  
 Loricata, 353  
 Loxura, 410, 411, 413, 425, 432  
   " atymnus, 130, 425  
 Lumbricidæ, 110  
 Lumbricus, *ib.*, 111  
   " novæ-hollandiæ, 111  
 Lycæna, 413, 415, 432  
 Lycænæsthes, 414  
   " bengalensis, 436  
   " lycænina, *ib.*  
 Lycænidæ, 121, 126, 127, 130, 409, 411  
   " 414, 415, 416, 416, 432  
 Lycænina, 127, 128, 411, 413, 414, 432  
 Lysimachia, 250  
 Magnolia, 369, 370, 371, 372  
 \* " Maingnyi, 369  
 Magnoliaceæ, 369, 368, 370, 371, 373  
 Magnoliad, 371  
 Magnoliæ, 368  
 Mahathala, 423  
   " ameria, 422  
 \* Malais, 414, 415, 436  
   " sriwa, 436  
 Manglietia, 369, 371  
   " Candollei, 373  
   " glauca, 370  
 \* " Scortechini, *ib.*  
   " Sebassa, *ib.*  
 Mantis undata, 307  
   " (Danuria) superciliaris, 306  
 Marshallia, 410  
 \* Massaga, 411, 417, 429  
   " clorinda, *ib.*  
 \* " hartertii, 128, 134  
   " pediada, 430, 431, 432, 440  
   " potina, 431, 440  
 Megalotrocha alboflavicans, 348, 358  
 Megisba, 413  
   " malaya, 435  
 Melanitis, 118, 120  
   " determinata, 118  
   " ismene, *ib.*  
   " leda, *ib.*  
 Melanochelys, 331  
   " trijuga, 328  
 Melicerta, 346, 350  
   " ringens, 346  
 Melicertadæ, 346

**Monispermaceæ, 359, 377****Menispermum crispum, 378**

- " fenestratum, 381
- " orbiculatum, 387
- " peltatum, *ib.*
- " triandrum, 382
- " tuberculatum, 378
- " verrucosum, *ib.*
- " villosum, 385

**Meta mixta, 342****Metopidia, 356**

- \* " angulata, *ib.*, 358
- " lepadella, 355, 356
- " solidus, 356
- \* " torquata, *ib.*, 358
- " triptera, 356

**\*Miagrammopes extensa, 342****Michelia, 369, 371**

- " aurantiaca, 371
- " Champaca, *ib.*
- " Doldoopa, *ib.*
- " montana, *ib.*
- " pubinervia, *ib.*
- " Rheedii, *ib.*
- " rufinervis, *ib.*

**Micropuccinia, 232, 236****Miletus hamada, 414****\*Minous inermis, 299****Moniligaster, 111****Monostyla bulla, 355**

- " cornuta, *ib.*
- " quadridentata, *ib.*

**Morphidæ, 124, 126****Mota massyla, 412****Muraenidæ, 304****Mycalesis, 118**

- " mineus, *ib.*
- " visala, *ib.*
- " (Sadarga) charaka, 123
- " " oculata, *ib.*

**Myitta, 409****Mynes, 126**

- " calydonia, 127

**Myriactis nepalensis, 251****Myrina, 304****Nacaduba, 409**

- " almora, 433
- " ardates, 432
- " atrata, *ib.*
- " dana, 433
- " macrophthalma, 432
- " pavana, *ib.*
- " viola, 433

**Naravelia, 360**

- " Finlaysonian, 361
- " laurifolia, 361

**Nelumbiæ, 389****Nelumbium, *ib.*, 390**

- " asiaticum, 391
- " mysticum, *ib.*
- \* " speciosum, *ib.*

**Nelumbo, *ib.***

- " Indica, *ib.*

**Nemeobiadæ, 432****Neocheirita, 410, 417**

- " hypoleuca, 417
- " martina, *ib.*

**Neomyrina, 413**

- " hiemalis, 160

**Neopithecops, 127, 128, 413, 414**

- " harpago, 128
- " zalmora, 435, 437

**Neorina, 124**

- " lowii, *ib.*
- " margaritæ, *ib.*

**Neotropidæ, 126****Nephila, 341**

- " maculata, 342

**Neptidæ, 126****Neptis, *ib.*****Nicoria, 331, 332**

- " annulata, *ib.*, *ib.*
- " edeniana, 332
- " spengleri, 331
- " thermalis, 332
- " tricarinata, 330, 331, 332
- " " var. eivalonsis, 333
- " trijuga, 328, 329, 331, 332, 333
- " " var. edeniana, 332
- " " thermalis, *ib.*
- " (Clemmys) trijuga, 327
- " (Melanochelys) 331
- " " trijuga, 328

**Nilasera centaurus, 417****Niphauda, 414**

- " cymbin, 435
- " tessellata, 414, 435

**Noteus quadricornis, 358****Notommata ansata, 352**

- " tripus, *ib.*

**Notommataw, *ib.*****Noviciæ Indicæ, 255****Nymphæa, 389**

- " Edgeworthii, 389
- " Hookeriana, *ib.*
- " Nelumbo, 391
- " punctata, 389
- " stellata, *ib.*, 390
- " " var. parviflora, 389
- " " versicolor, *ib.*
- " versicolor, *ib.*

**Nymphæaceæ, 359, 388****Nymphalidæ, 126, 127****Nymphalis, 126****Echistes, 347, 348, 350**

- " serpentinus, 348
- \* " stephanion, 347, 358

**Ophichthyina, 304****Origanum vulgare, 242****Ornithoptera, 416, 417**

- " brookiana, 416

**Orthezia, 2**

- Pachyarches, 416  
 Pachygonæ, 378  
 Padomma, 119  
 Paguridæ, 280  
 Panchala, 412  
     " ganesa, *ib.*  
 Pangeranopsis elephenor, 130  
 Papilio, 124, 415  
     " helenus, 124  
     " (Euptæopsis) telearchus, 130  
     " (Pangeranopsis elephenor, *ib.*  
 Papilionidæ, *ib.*  
 Paradanuria, 314  
     " orientalis, 315  
 Paragerydus, 415, 437, 440  
     " horsfieldii, 437, 438  
     " nivalis, 436, 437  
 \* " taras, 437, 440  
 Paramaccia, 356  
 \*Parascombrops, 296  
 \* " pellucidus, *ib.*  
 Parata chromus, 133  
 \*Paratoxodera, 317, 318, 319, 321  
 \* " cornicollis, 325  
 Parthenos, 126  
 Pedicularis, 255, 263, 264, 270, 274, 278  
     " acaulis, 275  
     " alaschanica, 261  
     " " var. tibotica, 261  
     " " var. typica, *ib.*  
     " Alberti, 264, 265  
     " albiflora, 273  
     " amœna, var. 261  
     " aspleniifolia, 273, 276  
     " " var. albiflora, 273  
     " " pubescens, 270  
     " bella, *ib.*  
     " bicornuta, 269, *ib.*  
     " binaria, 260  
     " brevifolia, 257, 258, 259  
     " cabulica, 275  
     " carnosa, 273  
     " cheilanthifolia, 261  
     " chumbica, 259  
     " Clarkei, 267, 277  
     " collata, 266, 267  
     " Collettii, 278  
     " comptoniæfolia, 265  
     " confertiflora, 258, 259  
     " corymbosa, 277  
     " orenata, 278  
     " curvipes, 275  
     " Daltoni, 270  
     " denudata, 258, 262  
     " doliohorrhiza, 275  
     " elephantoides, 269  
     " Elephas, 271  
     " Elwesii, 268  
 Pedicularis excelsa, 267  
     " fissa, 275  
     " flagellaris, 273  
     " flammea, 276  
     " " var. major, 276.  
     " flexuosa, 259, 260, 263  
     " fragilis, 263  
     " furfuracea, 273, 274  
     " " var. integrifolia, 274  
     " Gammieana, 260  
     " Garckeana, 267, 268  
     " gibbera, 262, 263  
     " globifera, 261  
     " gracilis, 257  
     " gruinæ, 272  
     " Heydei, 258  
     " himalayca, 271  
     " hirsuta, 276  
     " Hoffmeisteri, 269, 272  
     " Hookeriana, 271  
     " instar, 257, 258  
     " " var. paradoxa, 257, 258, 262  
     " " typica, *ib.*, *ib.*, *ib.*  
     " integrifolia, 261  
     " Kingii, 264  
     " labellata, 272  
     " lachnoglossa, 267  
     " longiflora, 271, 272  
     " lutescens, 265  
     " lyrata, *ib.*  
     " macrantha, 267  
     " " var. lutescens, *ib.*  
     " " typica, *ib.*  
     " megalantha, 269  
     " " var. pauciflora, 269  
     " " typica, *ib.*, 272  
     " microcalyx, 273  
     " mollis, 263  
     " nepalensis, 268  
     " ochroleuca, 267  
     " odontophora, 275  
     " Oederi, 265, 275, 276, 277  
     " " var. heteroglossa, 273, 276, 277  
     " " typica, 276, 277  
     " Olgae, 264  
     " Oliveriana, 257  
     " ophioccephala, 262  
     " orthantha, var. 264  
     " Pantungii, 273, 274  
     " pectinata, 255, 256  
     " " var. palaua, 255, 256  
     " " pyramidata, 256  
     " " typica, 255  
     " Perrottetii, 277

- Pedicularis polygaloides*, 258, 262  
 „ *porrecta*, 257, 250  
 „ *Prainiana*, 277  
 „ *Przewalskii*, 270  
 „ *punctata*, 271  
 „ *pycnantha*, 264, 265  
 „ „ *var. Semenowi*, 264  
 „ „ *typica*, *ib.*  
 „ *pygmaea*, 263  
 „ *pyramidata*, 256  
 „ *Regeliana*, 274  
 „ *Rex*, 266  
 „ *rhinanthoides*, 271, 272  
 „ „ *var. labellata*, 272  
 „ „ *typica*, *ib.*  
 „ *robusta*, 268  
 „ *Roylei*, 261, 262, 267  
 „ *rudis*, 277  
 „ *schizorrhyncha*, 260  
 „ *Scullyana*, 268, 269  
 „ *Semenowi*, 264  
 „ *semitorta*, 257  
 „ *siphonantha*, 271, 272  
 „ „ *Hookeriana*, 271  
 „ „ *var. brevituba*, *ib.*  
 „ „ *„(Elephas)*, *ib.*  
 „ „ *„(punctata)*, *ib.*  
 „ „ *typica*, *ib.*  
 „ „ *vera*, *ib.*  
 „ *superba*, 266  
 „ *tenuicanlis*, 259  
 „ *tenuirostris*, 256  
 „ *trichoglossa*, 267  
 „ *tubiflora*, 272  
 „ *tubiformis*, *ib.*  
 „ *versicolor*, 276  
 „ *verticillata*, 261, 262  
 „ *Wallichii*, 273  
 „ *zeylanica*, 278  
*Pediculati*, 302  
*Pellona*, 280  
*Penæidæ*, *ib.*  
*Pencetia prasina*, 335  
 „ *viridana*, *ib.*  
*Pentoloba*, 401, 404, 405  
 „ *lanceolata*, 404  
 „ *macrophylla*, 401  
*Percidæ*, 296  
*Pereira medica*, 381  
*Pericampylus*, 377, 385  
 „ *aduncus*, 385  
 „ *assamicus*, *ib.*  
 „ *incanus*, *ib.*  
 „ *membranaceus*, *ib.*  
*Perichæta*, 110, 111  
 „ *affinis*, 112  
 „ *annulata*, *ib.*  
 „ *aspergillum*, *ib.*  
 „ *birmanica*, *ib.*  
*Perichæta capensis*, 112  
 „ *darnleinsia*, *ib.*  
 „ *elongata*, *ib.*  
 „ *exigua*, 111  
 „ *fea*, 112  
 „ *hasselti*, *ib.*  
 „ *houletti*, 110, 111, 117  
 „ *indica*, 112  
 „ *japonica*, *ib.*  
 „ *musica*, *ib.*  
 „ *peregrina*, *ib.*  
 „ *quadragenaria*, *ib.*  
 „ *queenslandica*, *ib.*  
 „ *robusta*, *ib.*  
 „ *schmardæ*, *ib.*  
 „ *sieboldi*, *ib.*  
 „ *stuarti*, 110  
 „ *sumatrana*, 112  
*Periconyx*, 110, 111  
 „ *excavatus*, *ib.*, *ib.*  
 „ *m'intosni*, *ib.*, *ib.*  
 „ *saltans*, *ib.*, *ib.*  
*Philodina citrina*, 349  
 „ *erythrophthalma*, 352  
 „ *hirsuta*, 349, 358  
*Philodinadæ*, 349  
*Phlegra*, 334  
 \* „ *icioides*, *ib.*  
 „ *semiglabrata*, 335  
*Phragmidium*, 237  
*Pieridæ*, 119, 126  
*Pimpinella diversifolia*, 244  
*Pithecopis*, 128, 413, 414, 435  
 \* „ *fulgens*, 127, 134  
 „ *hylax*, 127, 435  
 „ *phœnix*, 128  
*Plagusia bilineata*, 290  
*Plantarum*, 359  
*Plastingia*, 132  
 „ *callineura*, *ib.*  
 „ *latoia*, *ib.*  
 \* „ *margherita*, 131, 134  
*Plesioneura alysos*, 131  
 „ *curvifascia*, *ib.*  
 „ *leucocera*, *ib.*  
 „ *sumitra*, *ib.*  
*Pleuronectes arsius*, 282  
*Pleuronectid*, 284  
*Pleuronectidæ*, 279  
*Plexippus paykulli*, 335  
*Ploima*, 352  
*Podocoryne*, 300  
*Polanisia icosandra*, 392  
*Pollinia nuda*, 243  
*Polynemus*, 280  
*Polyommatus bæticus*, 433  
*Pomatopus*, 296  
*Popa*, 307  
 „ *spurca*, *ib.*  
 „ *undata*, *ib.*  
*Poritia*, 413, 417, 428, 430, 432

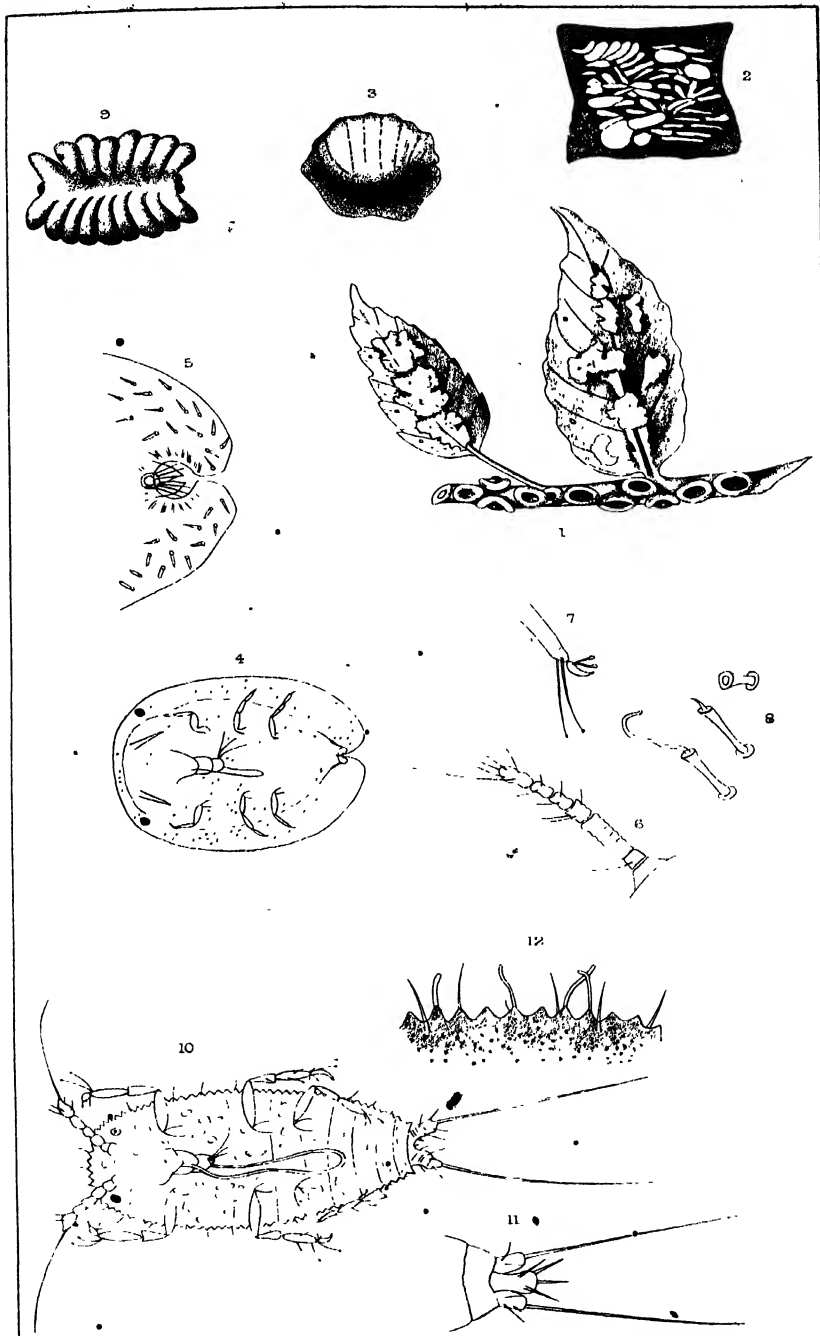


\**Poritia hewitsonii*, var. *tavoyana*, 429  
 „ *pediada*, 417  
 „ *phalena*, 129  
 „ *phraatica*, 429  
 „ *potina*, 429, 432  
*Poritiinae*, 128  
*Poritinae*, 513, 428  
*Potamis (Apatura) iris*, 126  
 „ „ *namouna*, 126  
 \* „ „ *ulupi*, 125  
*Precis iphita*, 126  
*Prionotus*, 304  
 \* „ *alepis*, 303  
 „ „ *birostratus*, *ib.*  
*Prosthesis*, 400, 301, 405, 406  
 „ „ *Javanica*, 403  
*Prothoe*, 123, 126  
 „ „ *angolica*, 127  
 „ „ *caledonia*, *ib.*  
 „ „ *regalis*, *ib.*  
 „ „ var., 126  
*Psettodes erumei*, 280  
*Pseudaxis*, 187  
*Pseudergolis*, 126  
 „ „ *avesta*, *ib.*  
 \**Pseudopulvinaria*, 1, 2  
 \* „ „ *sikkimensis*, 2  
*Pseudorhombus*, 280  
 „ „ *arsina*, 282  
 „ „ *javanicus*, *ib.*  
 „ „ *malayanus*, *ib.*  
 „ „ *russellii*, *ib.*  
 „ „ *tricellatus*, 283  
 \**Pterodina*, 356  
 \* „ „ *intermedia*, *ib.*, 358  
 „ „ *mucronata*, 356  
 „ „ *patina*, *ib.*  
*Pterodinadæ*, *ib.*  
*Puccinia*, 232, 233, 234, 236, 237, 238,  
 239, 240, 242, 244, 246, 249,  
 251  
 „ „ *Acetosæ*, 240, 241, 251.  
 „ „ *Adoxæ*, 235  
 „ „ *Andropogi*, 246, 251  
 \* „ „ *Anthistiria*, *ib.*, *ib.*  
 \* „ „ *Arundinellæ*, 245, 251  
 „ „ *Caricis*, 244, 250  
 \* „ „ „ *alicinæ*, 250, 251  
 \* „ „ *Chrysopogi*, 247, 251  
 „ „ *Circosæ*, 235, 236, 251  
 „ „ *coronata*, 248, 251  
 „ „ *fiosculosorum*, 238, 251  
 „ „ *Fragariæ*, 244, 251  
 „ „ *Galii*, 232, 239, 240, 251  
 „ „ *Geranii*, 237  
 „ „ „ *silvatici*, 236, 237, 251  
 „ „ *Graminis*, 249, 250, 251  
 „ „ *helvetica*, 241, 242, 251  
 „ „ *limosæ*, 250  
 „ „ *Menthæ*, 242, 243, 251  
 „ „ *Oreoslini*, 242

*Puccinia Phragmitis*, 246  
 „ „ *Pimpinellæ*, 244, 251  
 „ „ *Pollinæ*, 243  
 \* „ „ *Rosæ*, 232, 233, 251  
 \* „ „ *Roscoeæ*, 237, 251  
 „ „ *Rubiæ*, 232  
 „ „ *Saxifragæ*, 235  
 „ „ „ *ciliatæ*, 234, 251  
 „ „ *silvatica*, 250  
 „ „ *suaveolens*, 233, 242  
 „ „ *Taraxaci*, 238  
 „ „ *Urticæ*, 234, 251  
 „ „ *Valantiæ*, 239  
 „ „ *Vincæ*, 242  
 „ „ *Violæ*, 244  
*Pulvinaria*, 1, 2  
*Quercus incana*, 1  
*Radena*, 134  
*Ranunculacææ*, 359  
*Rapala amisena*, 424  
 „ „ *schistacea*, 428  
 „ „ *sphinx*, *ib.*  
 „ „ *suffusa*, *ib.*  
*Rattulidæ*, 353  
*Rattulus tigris*, *ib.*  
*Ravenelia*, 240  
*Remelana yajna*, 134  
*Rhamnus dohuricus*, 248  
*Rhoptomeris Burmanni*, 387  
*Rhinopalpa*, 126  
*Rhizota*, 345  
 \**Rhomboidichthys azureus*, 283, 295  
 „ „ *leopardinus*, 283  
*Rosa macrophylla*, 233  
*Rosococa alpina*, 237  
*Rotifer*, 350, 351  
 „ „ *macroceros*, 350  
 \* „ „ *mento*, *ib.*, 353  
 „ „ *vulgaris*, 350  
*Roydsia*, 396, 397  
 „ „ *floribunda*, 397  
 \* „ „ *parviflora*, 396  
 \* „ „ *Scortechini*, 397  
*Rubia cordifolia*, 241  
*Rumex nepalensis*, 240  
*Sadarga charaka*, 123  
 „ „ *oculata*, *ib.*  
*Salpina*, 354, 358  
 „ „ *brevispina*, 354  
 „ „ *eustala*, *ib.*  
 „ „ *macracantha*, *ib.*  
*Salpinadæ*, *ib.*  
*Salpinx*, 119  
*Samaris cristatus*, 291, 295  
*Sarcocarpon scandens*, 375  
*Satadra*, 422  
 „ „ *agaba*, *ib.*  
 „ „ *aida*, *ib.*  
 „ „ *atrax*, *ib.*  
 „ „ *rama*, *ib.*  
*Satarupa bhagava*, 133

- Satarupa narada*, 133  
*Satyridae*, 118, 120, 123, 124, 126  
*Saxifraga ligulata*, var. *ciliata*, 234  
*Scaridium longicaudum*, 353  
*Schizandrea*, 369, 375  
*Sciæna*, 280  
\* „ *ophiceps*, 300  
*Sciænidae*, *ib.*  
\* *Scianectes*, 284, 285, 292  
\* „ *lophoptera*, 284, 295  
\* „ *macrophthalmus*, 292, 295  
*Scombrops*, 296  
*Scorpænidae*, 297  
*Scoyllium*, 280  
*Sebastes*, 297  
\* „ *muciparus*, 298  
\* „ *serrulatus*, 297, *ib.*  
*Selenops malabarensi*, 335  
\* „ *montigena*, *ib.*  
*Semanga*, 413  
*Sephisa dichroa*, 125  
*Simiskina fulgens*, 431, 432  
*Sinthus amba*, 427  
\* „ *nasaka*, *ib.*  
*Siphonantha*, 278  
*Siphonanthæ*, *ib.*  
*Sithon*, 413  
*Solca hartzfeldii*, 285  
\* „ *oculus*, *ib.*, 295  
\* „ *ovata*, 285  
*Spalgis*, 414  
\* „ *epius*, 436  
*Sphasus*, 335  
*Sphinges*, 133  
*Stanneoclavi*, 336  
*Stephania*, 377, 385  
\* „ *discolor*, 386  
\* „ *hernandifolia*, *ib.*  
\* „ *hypoglaucha*, *ib.*  
\* „ *intertexta*, *ib.*  
\* „ *latifolia*, *ib.*  
\* *Stephanops dichthaspis*, 353, 358  
\* „ *lamellares*, 353  
\* „ *muticus*, *ib.*  
*Strobilanthes Dalhousianus*, 243  
*Suasa*, 411  
\* „ *lisides*, 426  
*Suasus*, 131, 132  
*Sumitra*, 131  
*Surendra*, 411  
\* „ *amisena*, 424, 425  
\* „ *florimel*, 409, 424, 440  
\* „ *Quercetorum*, 424, 425  
\* „ *vivarna*, 424  
*Symphædra dirtea*, 123  
\* „ *nais*, 121  
*Synaptura cornuta*, 287  
\* „ *quagga*, 286  
\* „ *zebra*, 286  
*Tagiades*, 131, 133  
*Tajuria jangala*, 427  
*Talauma*, 369, 372  
\* „ *Andamanica*, 372  
\* „ *Cambodianum*, 374, 375  
\* „ *evenium*, 374  
\* „ *Forbesii*, 373  
\* „ *Kunstleri*, *ib.*  
\* „ *lanigera*, 372  
\* „ *mutabilis*, 373  
\* „ *pumila*, 374  
\* „ *Rabaniana*, 372  
\* „ *villosa*, *ib.*  
*Talicada*, 434  
*Tanaecia*, *adima*, 122, 127  
\* „ *anosia*, 122  
\* „ *apiades*, *ib.*, 127  
\* „ *cibaritis*, 122  
\* „ *jahnu*, *ib.*  
\* „ *nicivillei*, *ib.*  
\* „ *pulasara*, *ib.*  
\* „ *puseda*, *ib.*  
*Taraka*, 411, 414, 415, 416  
\* „ *hamada*, 414, 436  
\* „ *mahanetra*, 414  
\* „ *mihi*, *ib.*  
*Taraxacum*, 238, 251  
\* „ *officinale*, 238, 243  
*Tarucus plinius*, 433  
*Teracolus*, 119, 120  
*Terias*, *ib.*, *ib.*  
*Testudinata*, 332  
*Testudinidae*, 328  
*Testudo*, 332  
*Tetracera*, 361, 362  
\* „ *Assa*, 362  
\* „ *Euryandra*, *ib.*  
\* „ *grandis*, 363  
\* „ *lucida*, *ib.*  
\* „ *macrophylla*, *ib.*  
\* „ *sarmentosa*, 362  
*Thamala marciana*, 417, 428  
\* „ *miniata*, 428  
*Thecla*, 410, 411, 412, 416, 423  
*Theclinæ*, 130, 409, 412, 413, 417  
*Thelyphonus*, 4, 5  
\* „ *andersoni*, 7, 11, 19  
\* „ *angustus*, 6  
\* „ *assamensis*, 6, 8, 19  
\* „ *beddomei*, 9, 10  
\* „ *binghami*, 7, 8, 15  
\* „ *formosus*, 6, 7, 8, 14, 16  
\* „ *indicus*, 4, 7, 9, 10, 19  
\* „ *insularis*, 7, 8, 13, 19  
\* „ *johorensis*, 7, 11, 19  
\* „ *nigrescens*, 4  
\* „ *psittacinus*, 8  
\* „ *rangunensis*, 4, 8, 18  
\* „ *saxatilis*, 4, 7, 8, 17, 19  
\* „ *scabrinus*, 8  
\* „ *sepiaris*, 4, 10  
\* „ *sylvaticus*, 4, 8, 18  
\* „ *wood-masoni*, 7, 8, 12, 19

- Theoclytes undata, 307  
 Theridion incoertum, 343  
 Theridion subvittatum, 342  
     "    vittatum, 343  
 Ticherra acte, 130  
 Tinomiscium, 377, 379  
     "    petiolare, 379  
 Tinospora, 377, 378  
     "    crispa, 378  
     "    nigiliosa, *ib.*  
 Tinosporæ, 377  
 Toxodera, 308, 317, 318, 319, 321, 325  
     "    denticulata, 323  
     "    spinigera, 319  
     "    tenuipes, 308  
     "    (Heterochaeta) tenuipes, 308  
 \*Toxoderopsis, 317  
 \*    "    spinigera, 319  
 \*    "    taurus, 320  
 Trachinidæ, 301  
 Trichera acte, 427  
 Trygon, 280  
 Typhæus, 110, 111, 115  
     "    gammi, 114, 115, 116  
 \*    "    masoni, 110, 112, 116, 117  
     "    orientalis, 114, 115  
 Uranoscopus, 301  
     "    cognatus, *ib.*  
 Urapteryx, 130  
 Uredinæ, 232, 250  
 Urtica parviflora, 234, 250  
 Ustilaginæ, 240, 246, 250  
 Utricularia, 346  
 Uvaria heteroclita, 376  
 Vanessa, 126  
 Vanessa, 126  
 Vareca lanceolata, 404  
 Vates ashmolianus, 312  
 Vatidæ, 306  
 Viola, 399  
     "    pilosa, 400  
     "    serpens, 244, 399  
     "    Wightiana, 400  
 Violaceæ, 399  
 Violareæ, 359  
 Violeæ, 399  
 Vcrta cella, 349  
 Winteriæ, 369  
 Wormia, 361, 364, 366, 367, 368  
     "    apetala, 366  
     "    excelsa, 364  
 \*    "    Kunstleri, 366  
 \*    "    meliosmæfolia, 365  
     "    oblonga, 364  
     "    pulchella, 365  
 \*    "    Scortechinii, *ib.*  
     "    subsessilis, 364  
     "    suffruticosa, *ib.*  
 \*Yasoda, 410, 411  
     "    tripunctata, 425  
 Zarona, 430  
 Zeltus, 411  
     "    ætolus, 427  
     "    etolus, *ib.*  
 Zephyrus, 411, 412, 417  
     "    pavo, 130, 417  
 'Zizera, 413, 434  
     "    pygmæa, 434  
     "    sangra, *ib.*

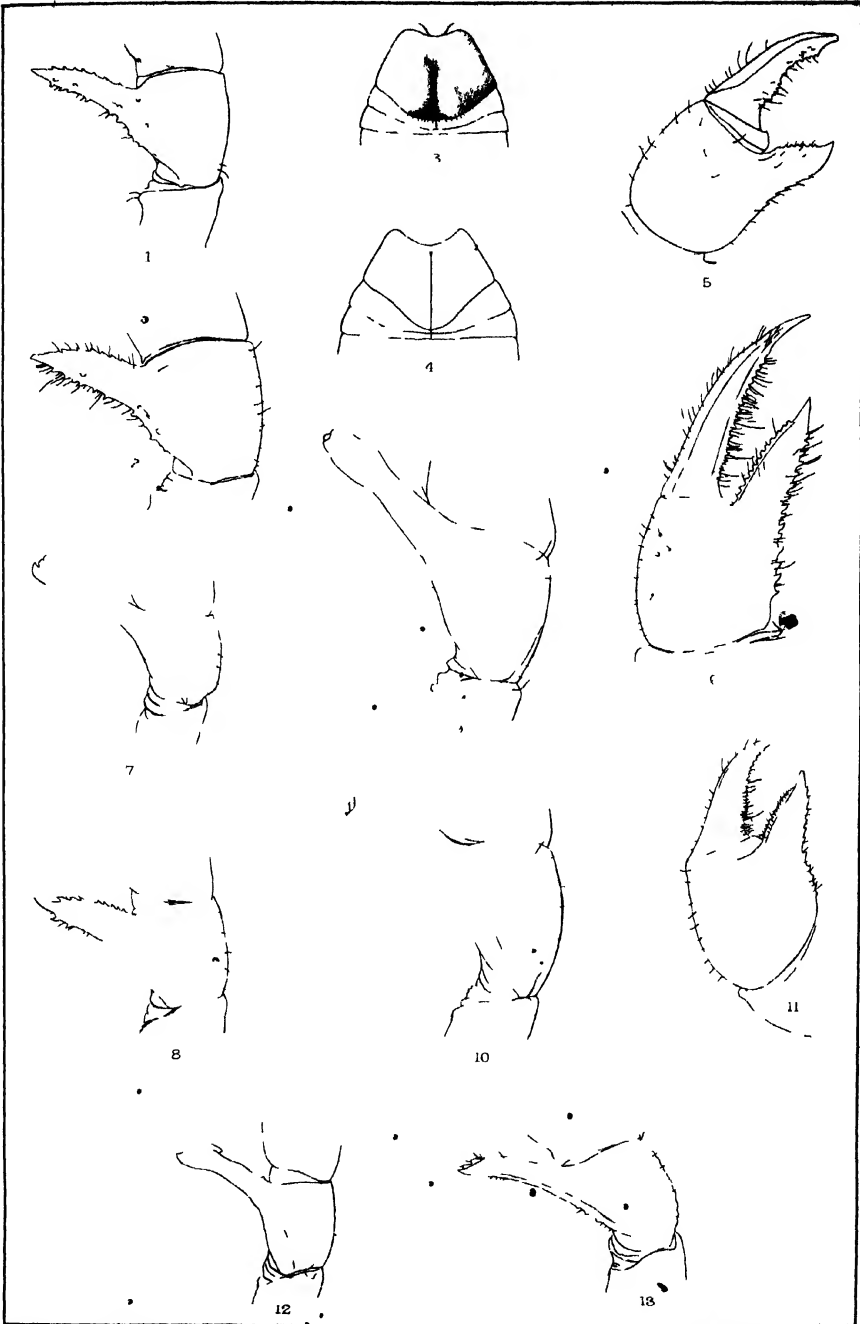


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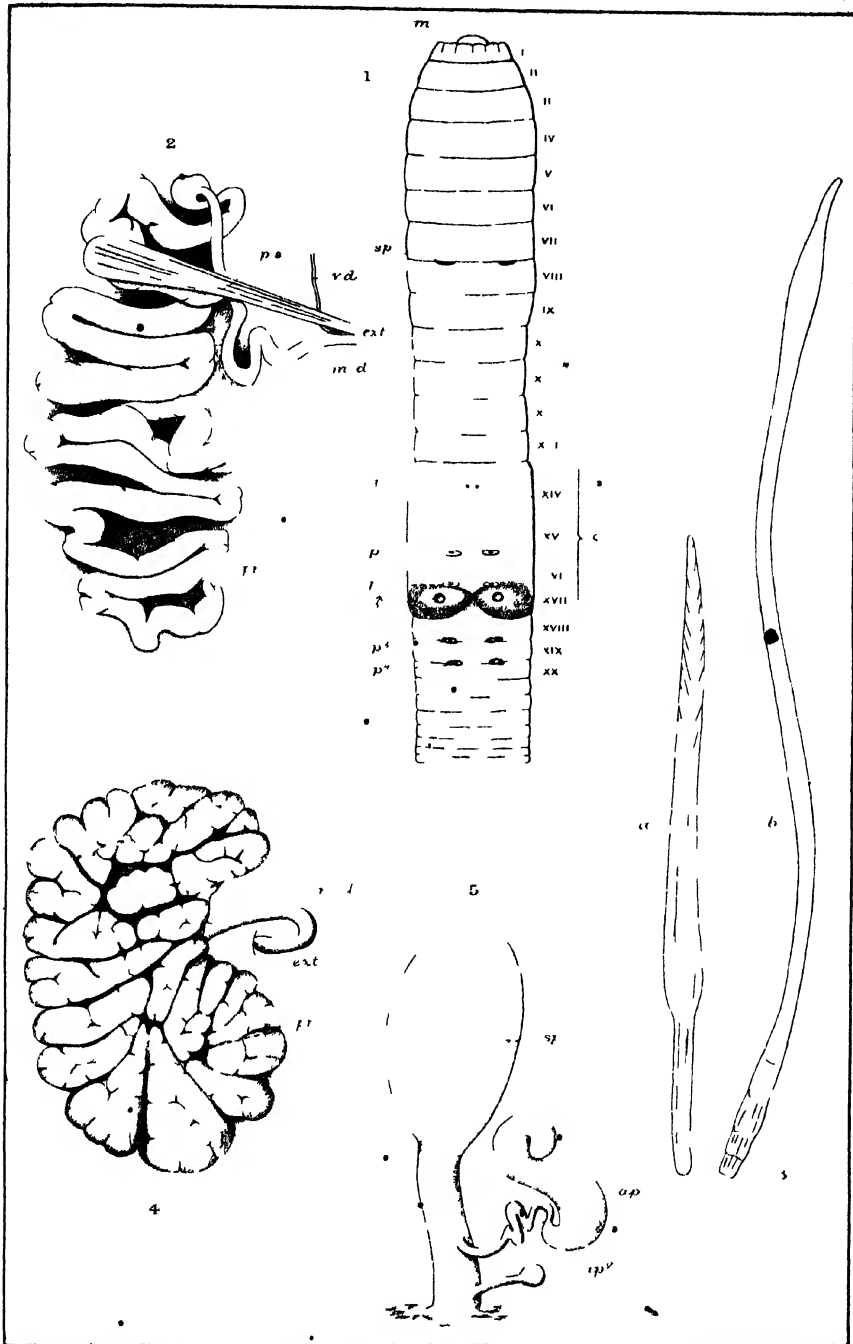
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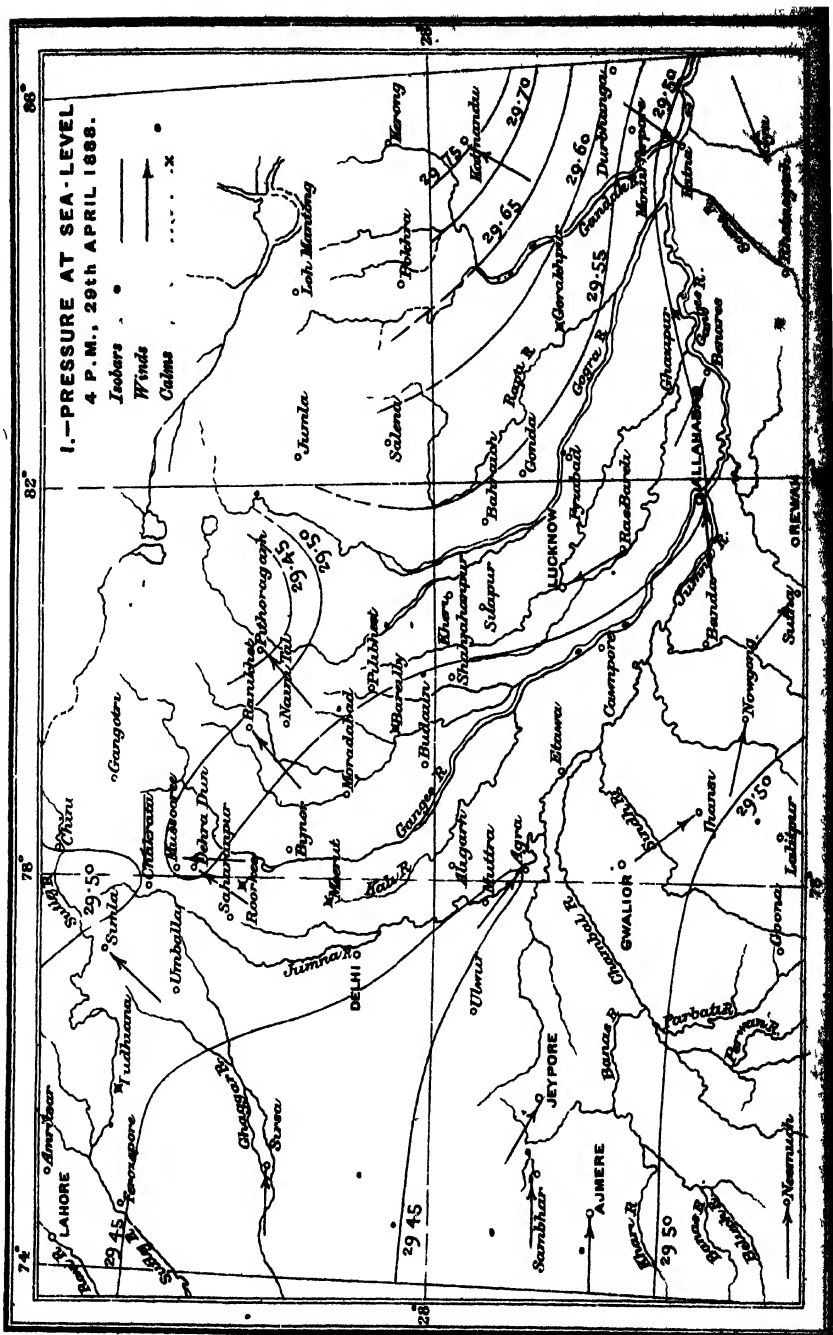




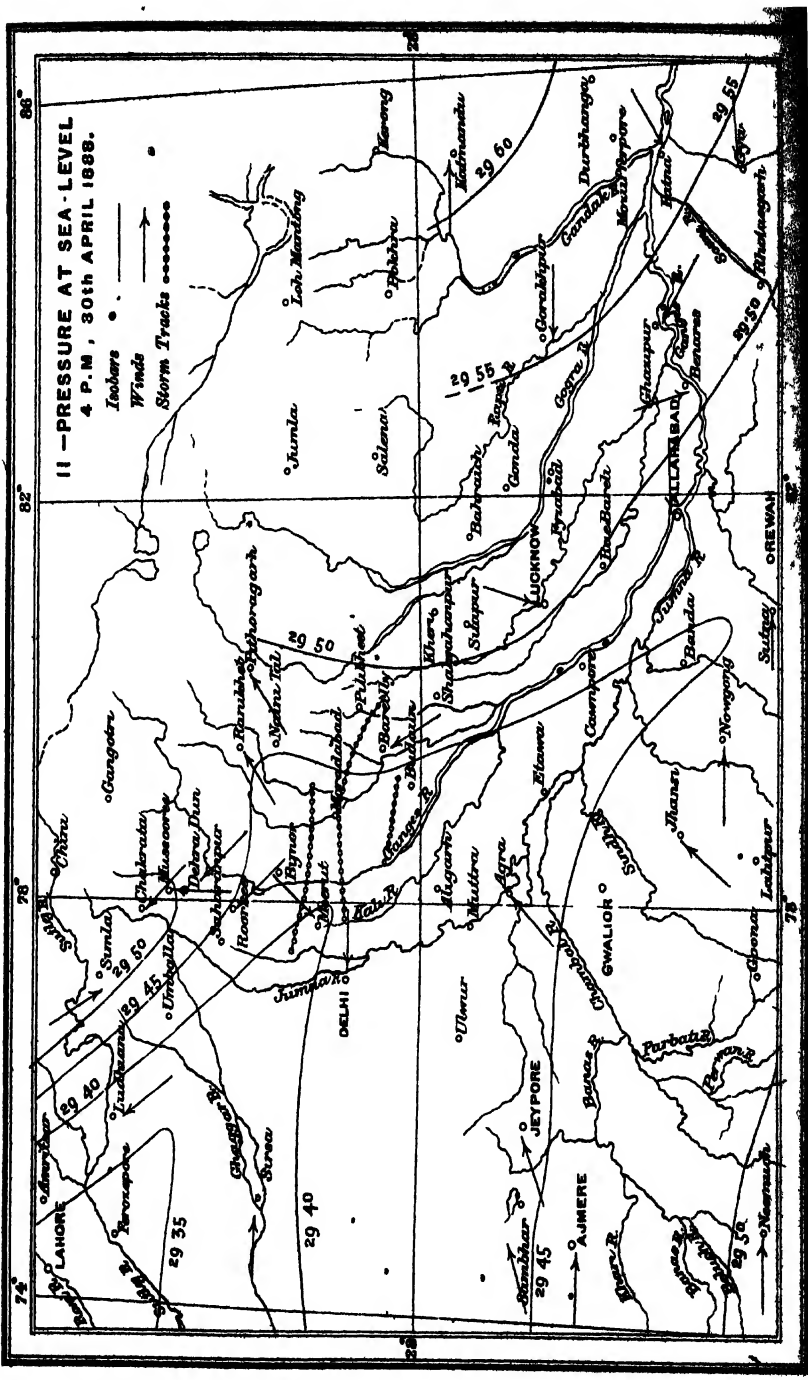




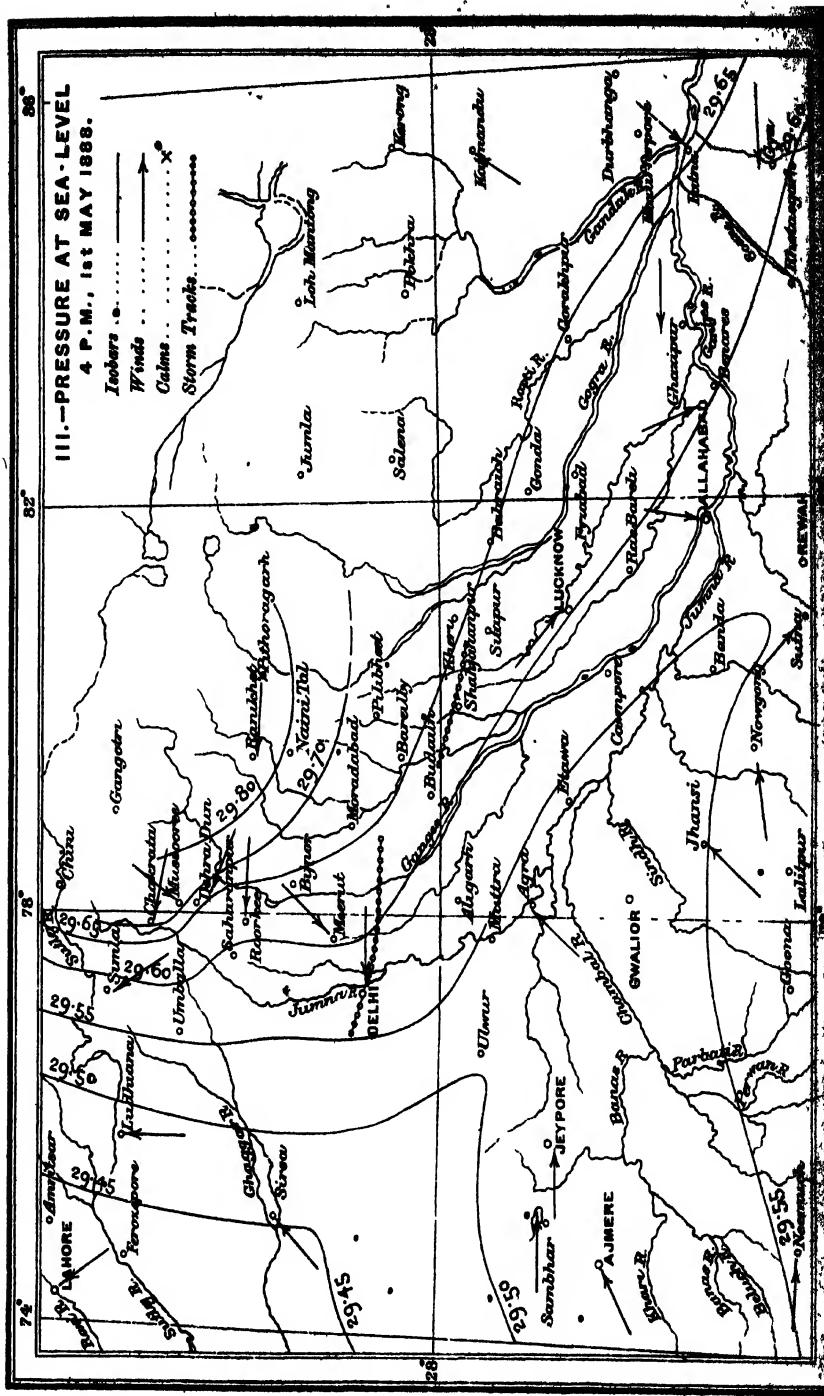




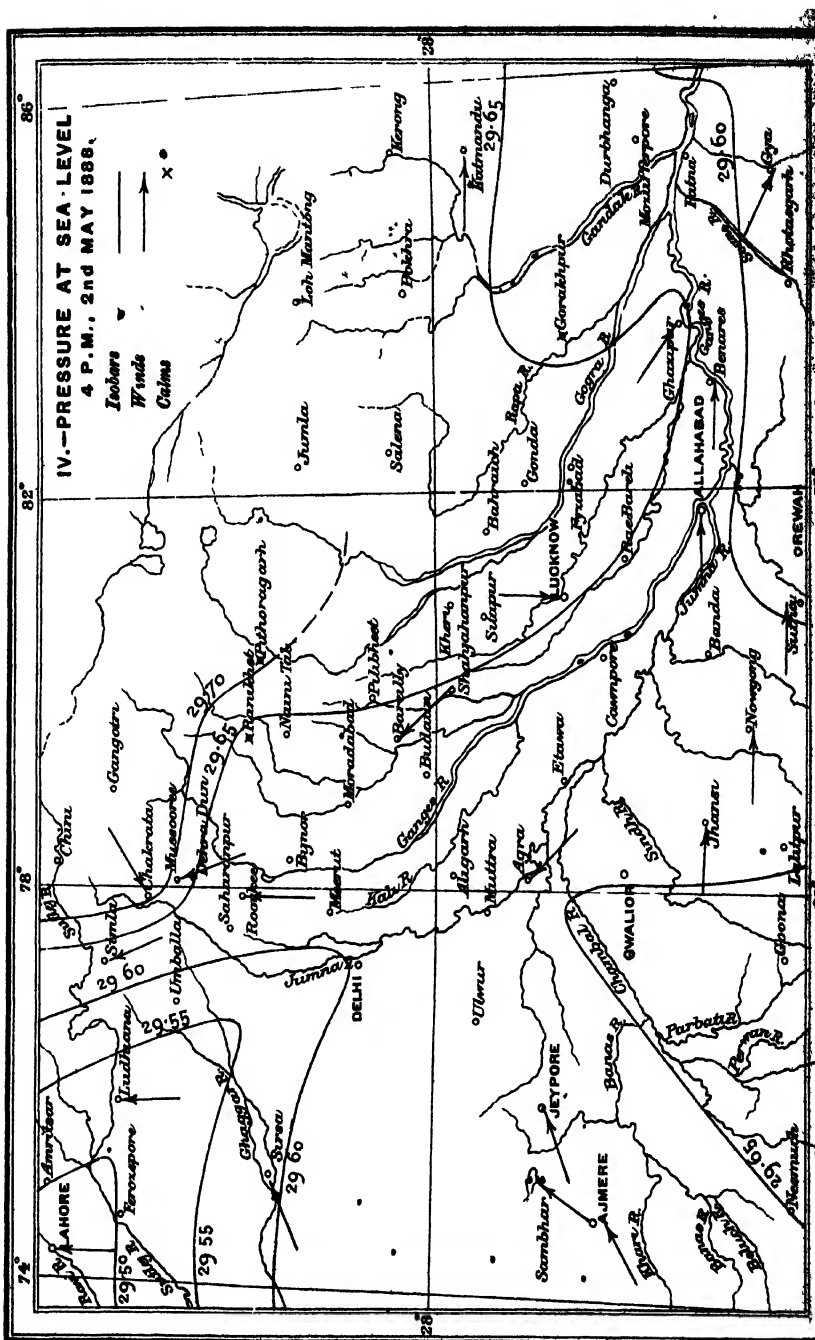






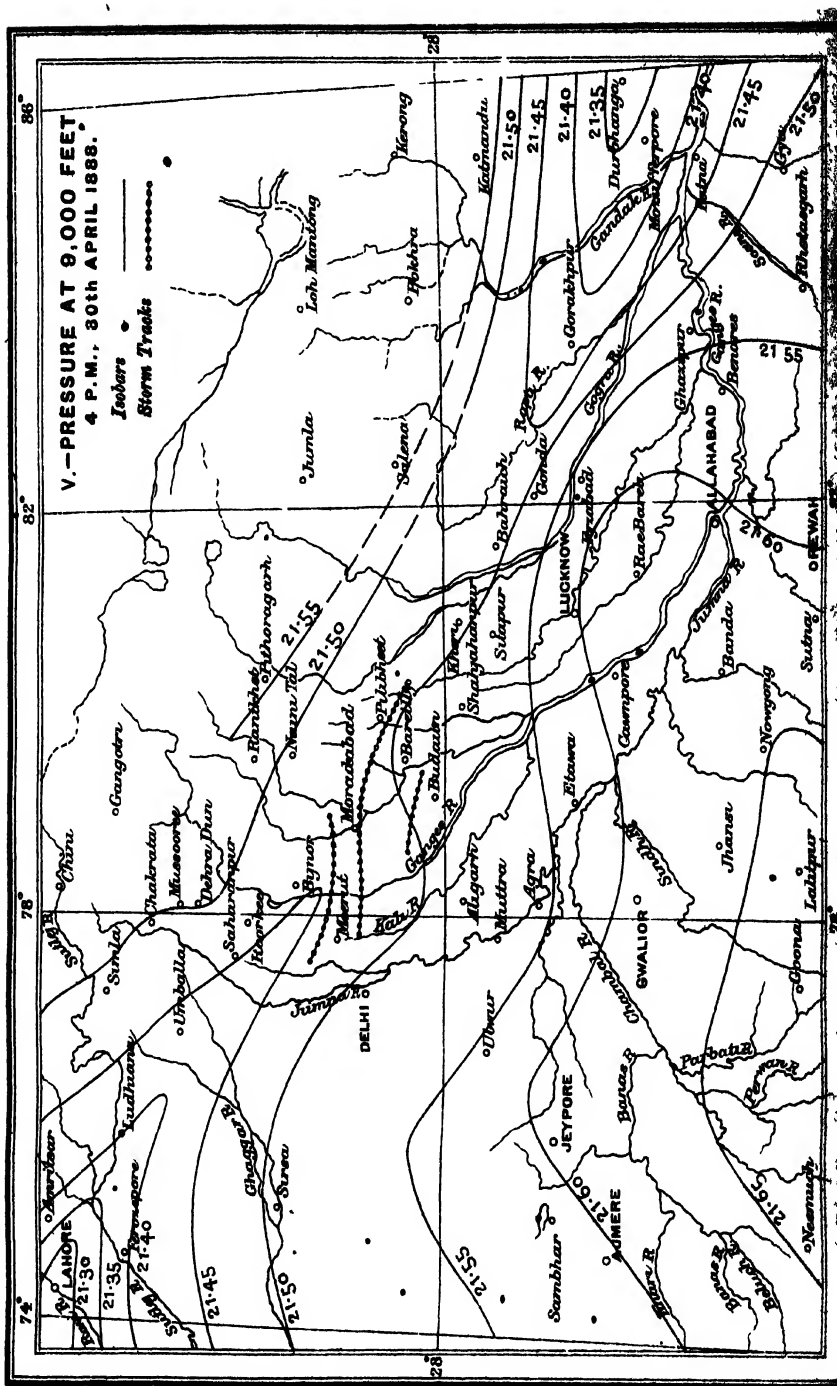














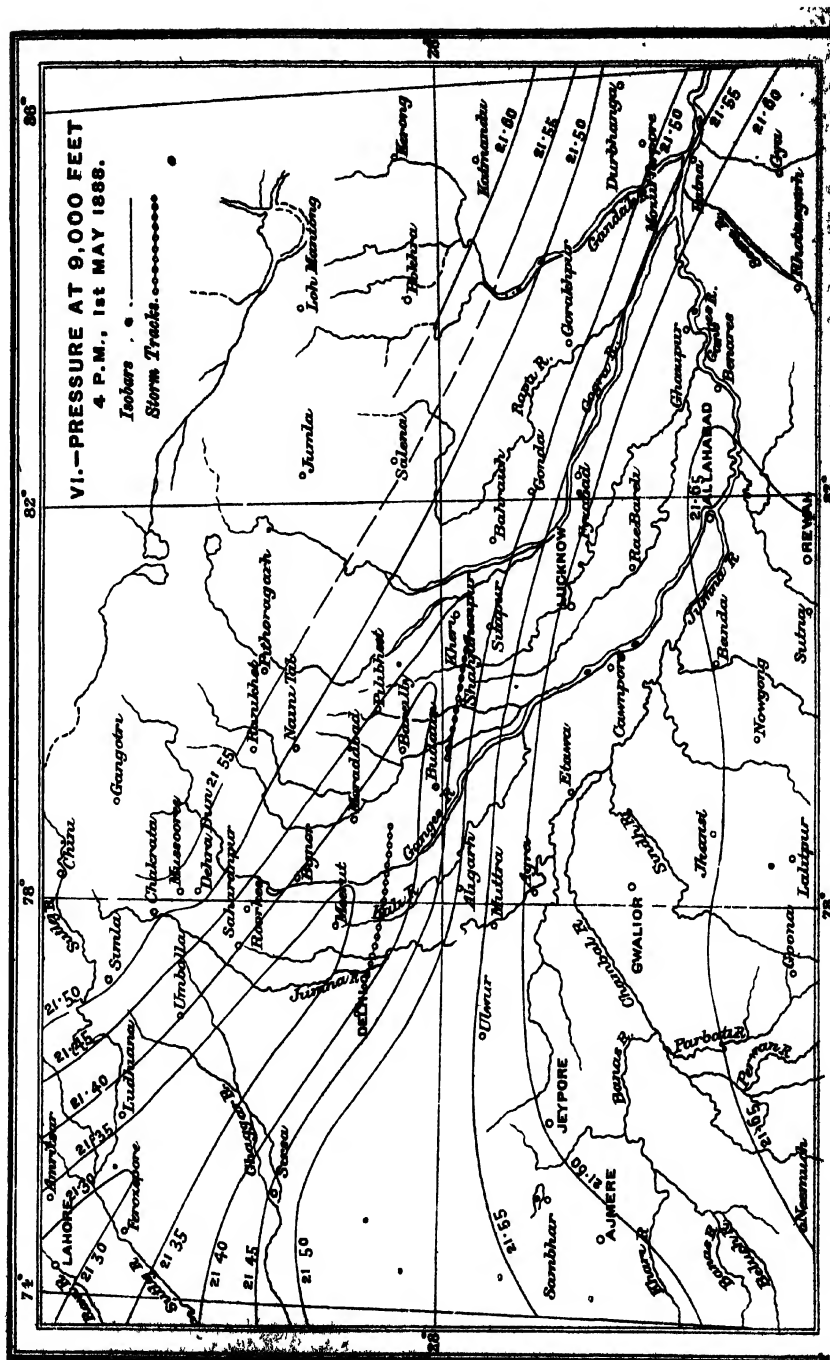




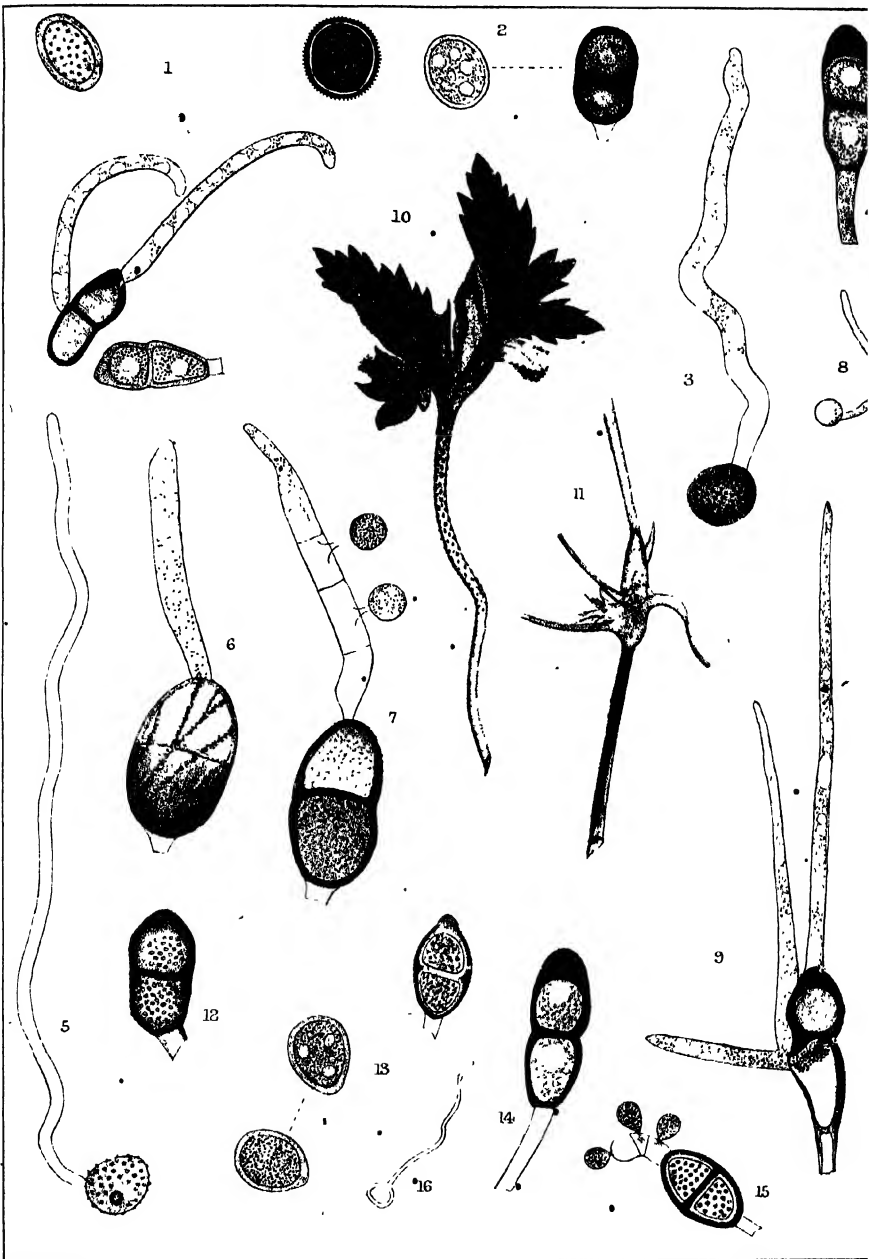


Photo etching

"The Great Horned Owl" The Great Horned Owl, March 1889

CERVUS DYBOWSKII











A. Barclay del.  
Parker & Cowan d lith

West Newman & Co









1.

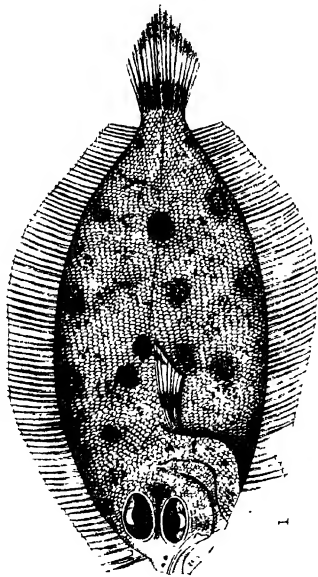


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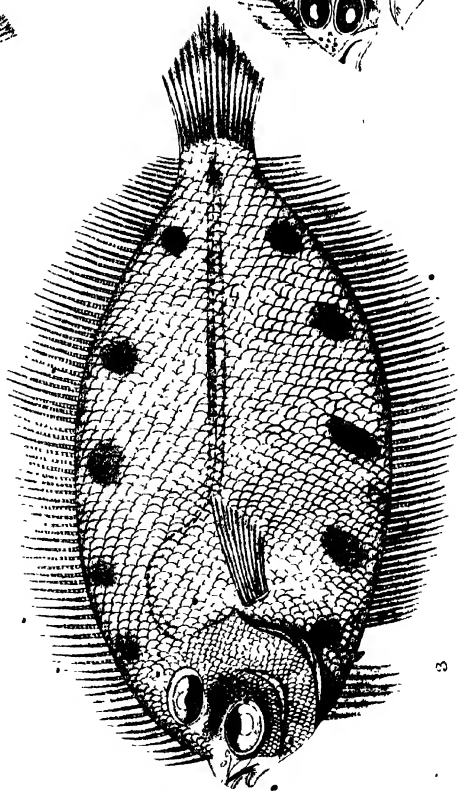
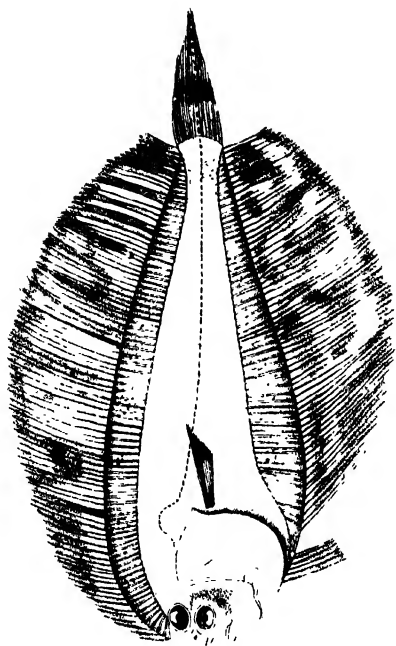


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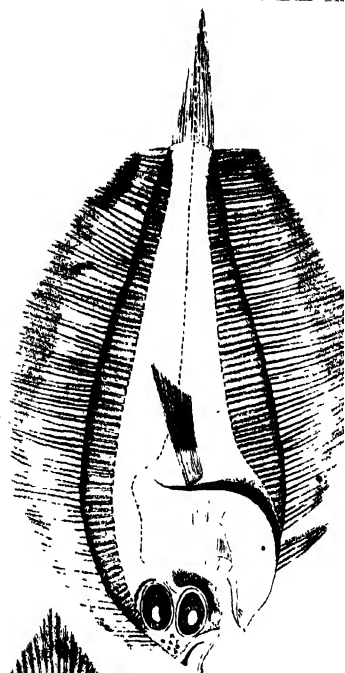




1



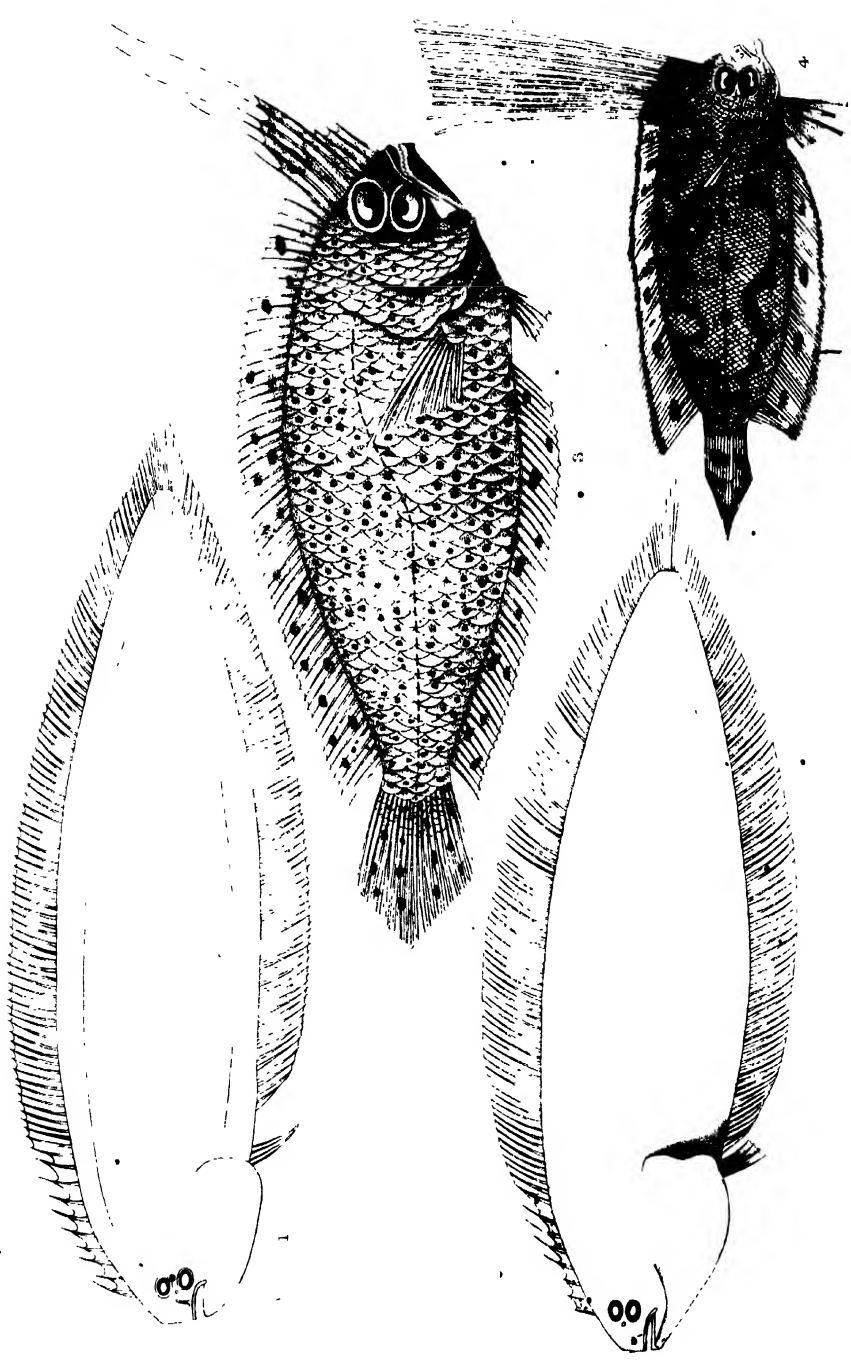
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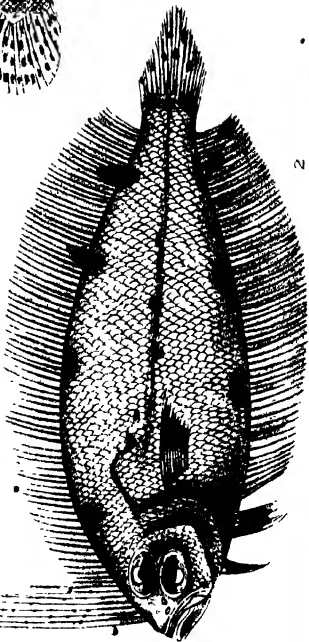
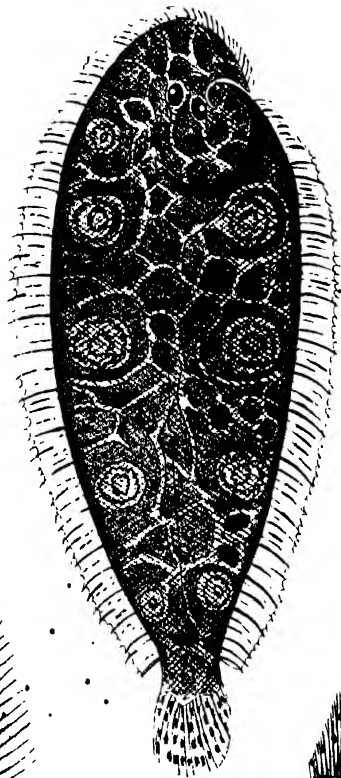
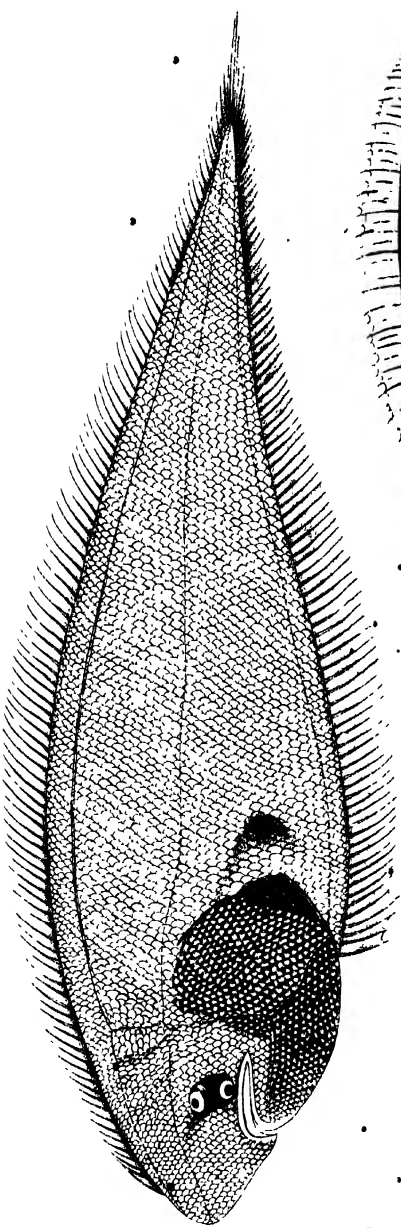




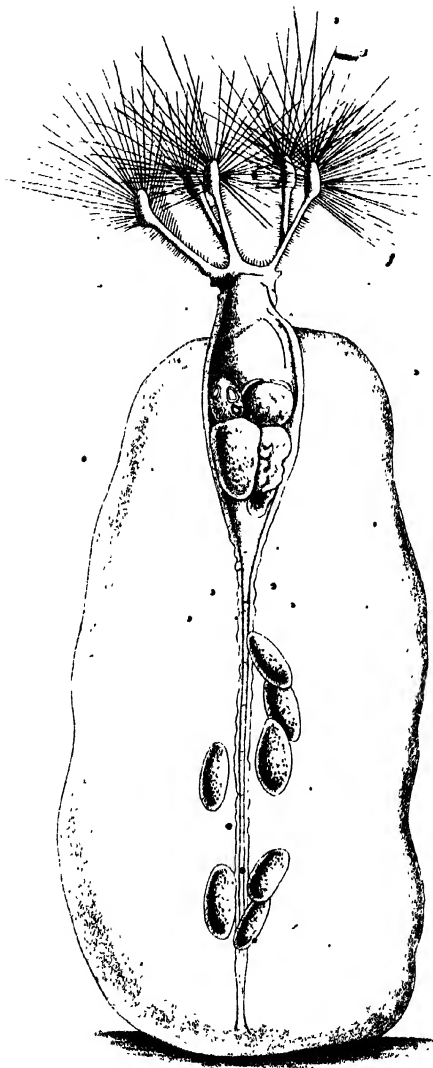
And 100% Genuine 100% Pure





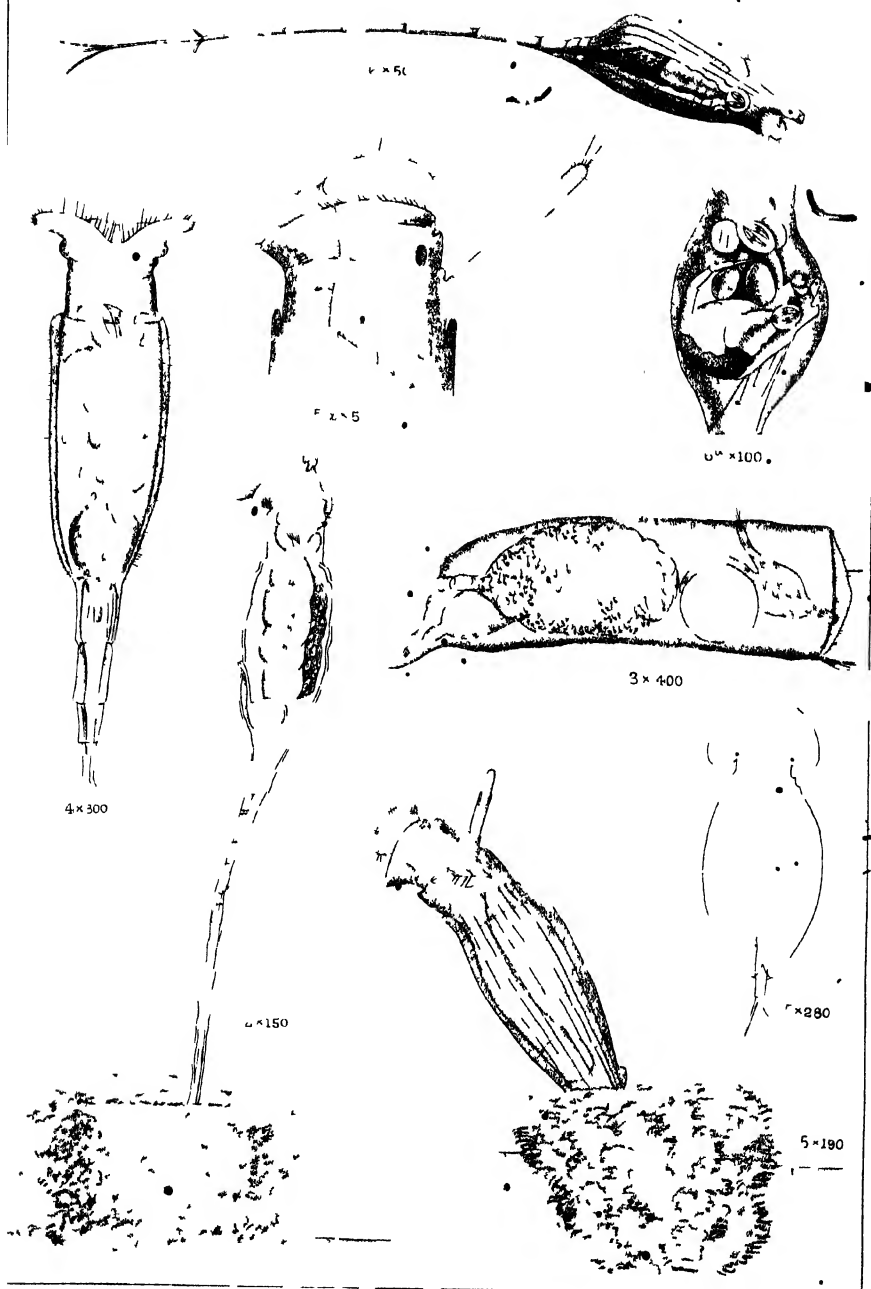






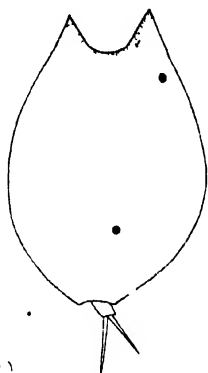
1. x 150







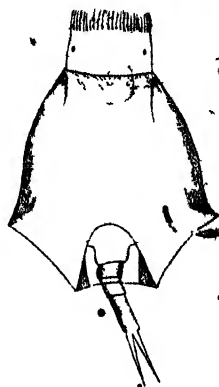




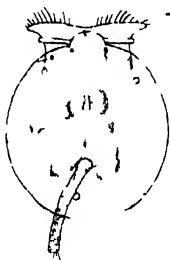
9 × 400



9<sup>a</sup> × 400



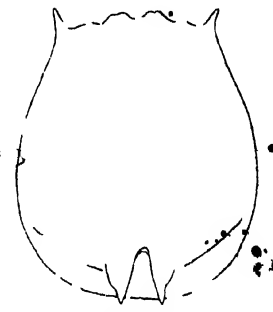
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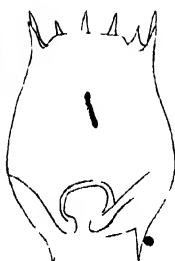
11 × 150



12 × 150



12<sup>a</sup> × 150



13 × 300



8 × 140



8<sup>a</sup> × 140



12<sup>b</sup> × 150



12<sup>c</sup> × 350



